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An investigation as to the extent, depth and character of the water horizons underlying Long Island have been made recently by Mr. N. H. Darton, of the U. S. Geological Survey. It has been found that the island is underlaid by many different sheets and streams of water, mainly of relatively restricted extent, and at various depths. They are not as orderly in arrangement as the regular succession of sheets of water which underlie New Jersey and some of the other regions southward, but they are very satisfactory water bearers, and will be found in greater or less number under nearly every portion of the island. They vary in depth from 20 to 1,000 ft. or more. The surface of the granite gneiss and other crystalline rocks slopes gently to the south and east, and is overlaid by a great mass of sands, gravels, and clays, which thicken rapidly to the south, so that along the south shore they have a thickness which averages about 1,000 ft. These beds are mainly coarse sands and gravels, which are filled with water, but in some areas the finer sands and even clays extend down to the bedrock, and in these areas no large water supplies would be found on the bedrock surface. This was the case in the well at Woodhaven, which was sunk to the granite, at a depth of about 550 ft., without finding water. There may be other areas of this sort, but in general wide areas of coarse, water bearing beds will be found on or very near the bedrock surface. Mr. Darton has advised the City Works Commissioner to sink wells to the bedrock before planning to extend the aqueduct system further eastward.

The shipment of oil in bulk on the Great Lakes is to be commenced by the Standard Oil Co., which is now building a large loading pier into Lake Michigan near its refineries at Whiting, Ind. This pier will be from 1,200 ft. to 1,400 ft. long, and from 14 ft. to 16 ft. wide. It will be built of piles driven in about 15 ft. of water, filled in with stone, and decked over. Specially constructed tank barges of 400,000 gallons capacity each are being built by the American Steel Barge Co., of West Superior, Wis., to transport the oil. This is, we believe, the first attempt to carry oil in bulk on the Great Lakes, although it is common practice to so ship it on the ocean. The pier has been designed and is being constructed under the supervision of Mr. C. McLennan, Civil Engineer, of Chicago. The contractors are H. B. Herr & Co., of Chicago.

The Pacific Short Line bridge over the Missouri River at Sioux City, Ia., work on which was suspended in May, 1893, will be completed at once, according to press reports. At the time work was suspended the substructure was partly completed, and nearly one-half of the steel for the superstructure had been rolled and a small portion manufactured. The suspension of work was caused by the failure of the Union Loan & Trust Co., of Sioux City, in April, 1893, which involved the Sioux City Terminal Ry. Co. and the Union Stock Yards Co., among whose assets was the unfinished bridge. The stockholders of these companies organized the Credits Commutation Co. to conserve their interests and get as much out of the wreck as possible. At a meeting of this company held May 20 a 10% assessment on the $4,000,000 capital stock was voted, the money to be used in completing the bridge. The contractors for the superstructure are the Phoenix Bridge Co., of Phoenixville, Pa., and for the substructure Sooysmith & Co., of New York city. Mr. J. A. L. Waddell, M. Am. Soc. C. E., of Kansas City, Mo., is Chief Engineer.

The household waste of New York city, says Street Cleaning Commissioner Waring, is well worth sifting out at the dumps. He believes that a sufficient amount of valuable material can be recovered and marketed to much more than pay for the cost of street cleaning and refuse gathering. Assuming the value of things recoverable and of a marketable kind at one cent per day per head of population, the aggregate would amount to the comfortable sum of $20,000 per day, or $7,300,000 per annum. Up to the present time the city has never received more than $100,000 per year from the dumps; though the "farmers of the dumps" are eager competitors for the privilege of sorting the refuse and are supposed to have made fortunes.

The most serious railway accident of the week was a rear collision May 22 near Cheyenne, Wyo., on the Union Pacific Ry. A southbound extra freight train ran into the rear of a passenger train, during a fog, and two men were killed.——A car running through the Alpine tunnel on the Denver, Leadville & Gunnison Ry. got beyond control on the steep grade, and several persons jumped. One man was killed and about twelve were injured.

A singular accident is reported to have occurred on the Kansas City, Fort Scott & Memphis Ry., near Williford, Ark., May 12. Both driving wheels on one side of the engine broke at the same time, while the train was running at good speed, but the engine did not leave the track.

One of the abutments for a new bridge at Woonsocket, R. I., is said to have cracked and to show signs of shifting.

The old East Hartford bridge at Hartford, Conn., was destroyed by fire May 17. It was an old wooden, covered bridge, built in 1818, and had six fixed spans and a drawspan. The latter and the masonry piers are all that are now left. Last year a contract for a new bridge was let to the Berlin Iron Bridge Co., but the state, which owned the bridge, has repudiated the contract, and the arrangements for its construction will have to be made by a commission representing several towns interested in the accommodation. The contract for a temporary bridge has been sublet by the Berlin Iron Bridge Co. to Dean & Westbrook, of New York.

The engines of the French steamer "La Gascogne" broke down during her latest trip from Havre to New York, but she arrived May 22, three days late, under her own steam. The accident was very similar to that which occurred on the same ship in February (Eng. News, Feb. 14), a piston breaking and repairs being impracticable, so that the middle pair of cylinders had to be put out of service. The engines were run at half speed after the accident, thereby preventing the trouble with the bearings which occurred in the previous instance. A new piston was supplied by the Morgan Iron Works, and the vessel sailed last Saturday—only 12 hours late.

A break of 65 ft. occurred May 18 in the embankment separating the Delaware & Hudson Canal from the Lackawaxen River near Honesdale, Pa.

A gas explosion occurred May 23 on Columbus Ave., New York, between 94th and 95th Sts. A new gas main was being tested, and a blow-out end at 94th St. was covered with gauze netting, and matches were lighted on the outside to see if any gas remained. The gas caught fire, and the gauze did not prevent the flame from entering the pipe. Several persons were injured by flying stones and mud, and damage was caused to shop fronts and windows.

The New York, New Haven & Hartford R. R. is said to have completed plans for the four-tracking of its system, and the elimination of the grade crossings in the five miles of the Providence Division which run through the city of Boston. The work will cost several million dollars, and will be in general similar to that on the Harlem Division, New York, the tracks being in a deep cut, with retaining walls. The land required for widening is said to have been purchased.

The intercepting and outlet sewer at Salt Lake City is 48 ins. diameter, instead of 54 ins., as originally planned, for a length of two miles. Where much water is encountered the concrete is composed of 1 part Portland cement to 2½ parts of sand and 3½ parts of gravel or broken stone, instead of 1, 4 and 5 parts respectively, as used elsewhere on the work. This increases the contract price from $6.60 to $7.75 per cu. yd. The time for completion has been extended to July 31. For the sewage farm 80 acres of land have been purchased by the city at $75 per acre. The contractors are Houlahan, Griffith & Morris, and Hobson & Wilkerson. This sewer was described in our issue of Jan. 4, 1894, and we are indebted to Mr. W. P. Hardesty, of Salt Lake City, for the above particulars.

The New York & New Jersey Bridge Commission has received three plans for its Hudson River suspension bridge. One is from Mr. Geo. S. Morison, M. Am. Soc. C. E., of Chicago, for a bridge with 3,080 ft. clear span; another is from Mr. J. W. Balet, of New York, for a span of 3,420 ft.; and the third is from J. B. Brewer.

A bill has been passed authorizing the Mayors of New York and Brooklyn to appoint a commission to select plans for and provide for the construction of a bridge over the East River, between Grand St., New York, and Broadway, Brooklyn.

A new street-sweeping machine known as the "Universal," was tried in New York city last week with satisfactory results. The machine is of the "pick-up" class, with a top hopper for collecting the dirt. A 26-in. broom sweeps the dirt up into a windrow, and a 31-in. broom running at 2½ times the speed of the other broom sweeps the dirt into a nearly vertical conveyor, the buckets of which drop the dirt into a large hopper or bin carried on trunnions. When the bin is full a cart is drawn alongside the machine and the bin tilted by gearing so as to discharge its contents into the cart. Two machines were run, one behind the other, making three trips through each street. They can sweep from 6 to 8 miles of street in eight hours. Each machine is drawn by three horses. The machines are owned by the Universal Street Sweeping Machine Co., of Boston, Mass. A fuller description will be given in a later issue.

The plans for the New York Rapid Transit Ry. which have been adopted by the Commission were approved by vote of the Common Council of the city on May 21. The next step will be to obtain the approval of the property owners along the lines, or, in lieu of that, the approval of a commission to be appointed by the Supreme Court, after which detailed plans and specifications will be prepared and the contract will be let.

Work is progressing on the Niagara Falls & Lewiston Electric Ry., which is to extend along the bottom of theNiagar River gorge, the roadbed being about 20 ft. above the level of the water. A great amount of blasting is required to cut a bench for the roadbed in the steep, rocky walls of the gorge. The line will be double track, standard gage, and will be equipped with observation cars, having all the seats facing the river. The contractors are Crage & Tench, of Buffalo, N. Y.

Water was turned into the Escondido irrigation reservoir, in California, from the San Luis Rey River on April 23. The dam is completed to about 45 ft., and water will be stored for this season's use. The works are being built by a district formed under the Wright law, and are to cost $350,000. Mr. E. F. Tabor is engineer for the district, and Mr. T. E. Doty is the contractor.

The inland water route from Cape Cod to Key West and the Gulf is to be tested by sending through the existing canals, bays and inlets the torpedo boat "Cushing," drawing 5½ ft. of water. The "Cushing" left the Washington Navy Yard on May 15 with orders to proceed to Key West and return to Newport, R. I., by June 15. Naval officers expect to prove that with less than 50 miles of sand cutting in all torpedo boats can traverse this interior route in case of war.

Gas engines are being used with success to operate barges running from the mouth of the River Seine to Rouen and Paris, in France. According to "Le Genie Civil" the engines are two-cylinder vertical engines, connected directly with the shaft, and are of 40 HP. Ordinary illuminating gas is used, and is stored in steel tubes under a pressure of 1,422 lbs. per sq. in. Each of these tubes is forged from a single piece of steel and is 9.49 ins. exterior diameter, 16.4 ft. long, and has a shell 0.31 in. thick. The weight of each tube is 715 lbs., and the capacity 776 cu. ft., and they are all placed in a battery on the deck of the barge. The gas mixed with air is exploded in the cylinders by electricity. The barges are 98.4 ft. long, 18 ft. beam and 8.38 ft. molded depth. Their registered tonnage is 300 tons, and it is calculated that the machine takes up so little space that the actual load will come up to 250 tons. Tests made with the barge show that at from 180 to 250 revolutions it will make a speed of from 6 miles to 6.8 miles per hour with a load of 145 tons.

THE CHICAGO MAIN DRAINAGE CHANNEL.

II.

The Specifications for the Work.

The first work of the Board of Trustees after deciding upon the routes and cross-sections of the main drainage and river diversion channels was to formulate a general policy for carrying out the construction, and to prepare plans and specifications preparatory to letting the contracts. It was decided (1) to put the more difficult portions of the work under contract first, and (2) to divide the channel into a large number of short sections, and limit the number of sections to be let to a single contractor. The idea was, of course, to give the contractors for the rock sections the greater length of time in which to complete their work, which the greater hardness of the material necessitated, and to bring the size of the separate contracts well within the ability of the ordinary contractor to handle, thus making possible a widespread competition for the work. The reduction of the size of the contracts and their division among a number of contractors have also been of decided advantage in the disputes which have arisen between the contractors and the trustees. For example, in the trouble arising over the cemented gravel and clay on Section E—which will be touched upon in another article—the work was taken from the original contractors and relet without at all affecting or involving a delay in the work on the neighboring contract sections. If these contractors had controlled the work on a dozen sections, it will readily be seen that the delay in the work of the channel as a whole, and the difficulties of adjusting the dispute, might have been immensely increased. As it was, the whole difficulty began and ended with a single contractor and a single section of the canal less than a mile in length.

In drawing up the earlier specifications for the excavations, two classifications of material were adopted, viz., "solid rock" and "glacial drift," the latter comprising all material either hard or soft other than solid rock. The contractors were required to base their bids for excavating glacial drift on the results of borings 3 ins. in diameter made along the whole length of the line. It had been intended by the first Chief Engineer, Mr. L. E. Cooley, to sink a series of test pits instead of these small borings, but this plan was overruled by the first Board of Trustees, and the pits were never sunk. The error of this action of the Trustees had far-reaching results, for, owing to a combination of peculiar material and inefficient inspectors to record the borings, an entirely misleading idea was obtained of the hardness of the glacial drift on certain sections. In fact, it is doubtful if, with the most careful attention to conducting and recording the borings, they would have indicated with any truthfulness the exact character of some of this material. From the information obtained from these borings, however, the relative quantities of solid rock and glacial drift to be excavated were calculated, and specifications were prepared.

As far as possible, with due consideration to the varying material and conditions, the terms of the specifications were made uniform for both the solid rock and the earth channels. In the following paragraphs the principal provisions of the specifications for both classes of work have, therefore, been combined, and such explanations are given as are necessary to make the differences clearly understood.

A profile of the surface of the ground approximately on the line of the channel was furnished to each bidder, accompanied by the statement that although it was considered that these profiles were approximately correct, they did not pretend to be absolutely so. The relative quantities of glacial drift and rock were also stated to be approximate, and the contractor was warned that he took all risk in the variation of these quantities from the figures given. The results of the borings referred to were indicated on the profile. Before the entire canal had been put under contract, trouble had arisen over the quality of the material encountered, it being claimed by the contractors that the borings were inaccurate, and the specifications for subsequent contracts were modified to state, in addition to what it said above, that bidders must satisfy themselves as to the quantity and quality of the materials. In the contracts for Sections (G to O), inclusive, the term "glacial drift" was changed to "excavation."

Continuing, the specifications stated that when the channel was in rock, the sides were required to be worked out with channeling machines from top to bottom. If the depth of the rock did not exceed 16 ft., subsequently changed to 12 ft., but one cut of the channeling machine was to be made, and if it did not exceed 24 ft. but two cuts were to be made. Under no circumstances were there to be more than three cuts. Each of the succeeding cuts was to have an offset of 6 ins. from the cut immediately preceding. The rock was to be taken out in two or more stopes or lifts, as the contractor desired. Where the channel was partly in earth and partly in rock, the earth was to be so excavated as to leave a berm on top of the rock equal in width to three-eighths of the depth of the rock surface below a level of 5 ft. above datum, provided that in no case should this width be less than 5 ft. On this berm the retaining wall was to be built.

When the channel was entirely in earth, the width on the bottom was to be 202 ft., and the slope on the sides 2 ft. horizontal to 1 ft. vertical, except in the temporary channel sections F. to O, inclusive, where the width of the bottom was to be 110 ft. The manner of excavation was left to the will of the contractor, but the disposition of the spoil was limited to certain places. The location of the spoil banks varied for different parts of the channel. All materials, such as trees, fences, buildings, etc., within 150 ft. of the center line of the channel were to be removed by the contractor and to become his property. The contractor was required to provide all pumping machinery and bear all the expense of draining the channel until the whole work was fully completed.

Wherever the top of the rock at the sides of the channel was below 5 ft. above datum, it was specified that retaining walls of masonry laid in cement mortar were to be built. If the bottom of the channel was in rock, the walls were to be founded on rock, and if the bottom was in earth, the walls were to be founded upon a footing made in a trench dug not less than 1 ft. below grade, and as much deeper as the engineer might specify. The footing was to project 1 ft. beyond the face The top of the wall was to be 5 ft. above datum and 4 ft. wide, except on Sections 14 and 15, where the channel is in embankment, and a top width of 6 ft. is specified. The thickness of the walls at the bottom was to be not less than one-half their height, providing this was not less than the width at the top plus the total batter. The backs of the walls were to be stepped, and the fronts smooth and flush with the edge of the channel at the bottom. The width across the channel between the inner edges of the tops of the walls was to be 166 ft. The cross-section of the walls on Sections 14 and 15 differs from the above in that the cross-section is designed to retain water.

The material used in constructing the walls was to be stone taken from the channel. All stone were to be laid on their quarry beds in courses not less than 12 ins. and not more than 30 ins. in thickness. No stone was to be less than 12 ins. thick. All stones were to be laid so as to break joints with the stones in the course below. American natural cement mortar, made of equal parts cement and sand, was to be used in laying the masonry. It was intended at first to lay the retaining walls dry, but upon getting down to the rock it was found to be of such poor quality, that in the opinion of the engineers it was not suitable for dry masonry work, and the specifications were altered to provide for cement mortar masonry. The space between the retaining walls and the bank of the excavation was to be filled with broken stone.

All along the river diversion work, the specifications required a levee to be constructed between the river channel and the drainage channel. This levee was to be built of spoil from the two channels and carried to a height well above that of the highest known high water mark. Where necessary the levee was to be carefully riprapped on the slope next the river diversion channel. There were about 19 miles of levee on the canal.

Strict regulations were drawn regarding the responsibility of the contractor for accidents, damages to property, etc. No subcontracts were allowed. This stipulation, it may be noted here, was repeatedly violated, many of the contractors subletting a very large portion of their work. A thorough system of measuring the quantities excavated and paying for the same was specified. Two estimates were to be made each month, and payment made for a yardage of 87½% of the estimate. The specifications also provided that:

> If the manner of conducting the work is such that at the time of making any progress estimate a markedly greater proportion of the top material has been excavated than of the bottom material, then the Chief Engineer shall in making such estimates ascertain what amount has been excavated up to that time of any material lying above, and what below, a horizontal plane dividing the mass of said class of material into equal parts; and if the upper portion exceeds the lower, then the total amount of material found to have been excavated shall be reduced by 10% of said excess, and estimates or certificates issued on the remainder, with the percentage deductions provided, viz., 12½%.

The work required to be done each month was to be not less than such a proportion of the whole work as one month was of the total number of months agreed upon for the completion of the work. The first two months from the date of contract and the last two months before the date of completion were each held to count one month in progress.

Regarding the failure of the contractor to keep up to the monthly progress requirement, the specifications read as follows:

> If the work to be done under this contract shall be abandoned, or if it shall be assigned by the contractor, or if he loses control of the work from any cause, excepting acts of God and the public enemy, or if the rate of progress is not such as to insure its completion within the time specified, or, if at any time the Chief Engineer shall be of the opinion, and shall so certify in writing, that said work, or any part thereof, is unnecessarily and unreasonably delayed, or that the contractor is willfully and persistently violating any of the conditions or covenants of this contract, or is not executing said contract in good faith, the Sanitary District of Chicago shall have the power to notify said contractor to discontinue all work, or any part thereof, as may be designated, and shall thereupon have the power either to complete said work by contract or to employ such men and teams, and to obtain such machinery, implements and tools, and to purchase such material as the said Chief Engineer may deem necessary to complete the work herein described, or any part thereof. And in so doing said chief engineer may use such tools, implements and materials as may be found upon the line of said work. The cost of doing such work shall be charged to the said contractor, and any moneys that may then be due, or may at any time thereafter become due, to said contractor under and by virtue of this contract, shall be applied to the payment of such cost, so far as same shall suffice therefor, and the remainder of the cost of so completing said work, if any, shall be paid by said contractor on demand.

The terms of this last clause of the specifications are given in full, for upon them have been based the actions of the Board of Trustees in declaring certain contracts forfeited and reletting them to new contractors.

The operation of the forfeiture clauses in the specifications has been satisfactory, as evidenced by the successful abrogation of the original contracts for eleven of the contract sections and the reletting of the same.

A pretty complete understanding of the requirements of the work and the conditions under which it was undertaken by the contractors will be obtained from the foregoing paragraphs. The principal difficulties which have arisen came from the insufficient information furnished regarding the quality of the material on certain sections. In the articles immediately following this, the description of the methods adopted for doing the work on each of the contract sections, beginning at the eastern terminus of the canal, will be described.

It should first be noted, however, that for the purpose of carrying out the engineering work the whole channel was divided into four "divisions," which, commencing at the eastern terminus of the channel, are known as the Summit, Willow Springs, Lemont and Lockport divisions. Each division is in charge of a division engineer, who has his office at the town from which the division is named. The present Division Engineers are: Mr. E. R. Shnable, Summit Division; H. B. Alexander, Willow Springs Division; H. A. Miller, Lemont Division, and C. L. Harrison, Lockport Division.

BRICK ARCH CULVERTS; ST. LOUIS, KEOKUK & NORTHW'N R. R. EXTENSION.

In our issue of June 14, 1894, we described briefly the work done by the Chicago, Burlington & Quincy R. R. in improving its terminal facilities in the city of St. Louis, Mo., and illustrated in some detail the turning and lifting machinery of the swing span of the new bridge at Alton, Ill. In addition to this bridge and another large bridge across the Missouri River at Bellefontaine Bluffs, there were a number of minor structures of interest on this work, and we illustrate two of these in the accompanying cuts. Both of these structures are excellent examples of large masonry culvert work.

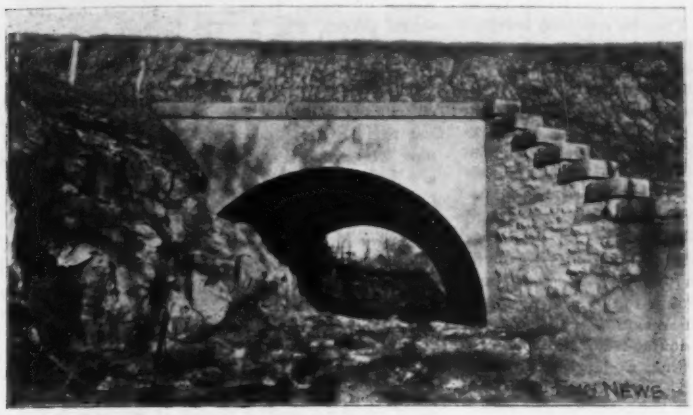

FIG. 1. VIEW OF COMPLETED CULVERT OVER COLDWATER CREEK, ST. LOUIS, KEOKUK & NORTHERN R. R, MISSOURI.

FIG. 2. VIEW OF COLDWATER CREEK CULVERT UNDER CONSTRUCTION, SHOWING ARCH CENTERS.

Chief Engineer, Geo. S. Morison, Pres. Am. Soc. C. E, Chicago, Ill.

The first of these culverts, counting from the north, is at the crossing of Cold Water Creek, about 2 miles from the Missouri River and 14 miles from St. Louis. The stream crosses the roadbed at nearly right angles, and its bed is on solid limestone, one side being a comparatively steep rocky bluff, and the other side a narrow piece of flat bottom. The rock is sound, and it was determined to make use of the high side as one of the haunches of the arch. Views showing the completed culvert and the work in progress of construction are given in Figs. 1 and 2. Fig. 3 is a cross-section, showing the dimensions in detail.

A new channel was excavated in the limestone at right angles to the roadbed. The arch springs directly from the limestone on the south side as

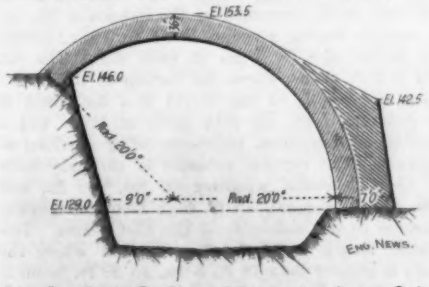

Fig. 3. Cross Section of Coldwater Creek Culvert.

a full centered arch of 20 ft. radius and is 90 ft. long. It subtends an angle of 135°, and rests on a skewback cut in the rock on the north bank. The arch is built of eight courses of brick, making a total thickness of 36 ins. The courses are all laid horizontally, and the separate rings are not bonded together. The parapets are of brick with Romona stone copings. The wing walls are of rubble masonry and are backed with concrete, as are also the haunches.

The brick masonry is laid throughout in 2 to 1 Portland cement mortar, and the concrete was made with Louisville cement. The concrete is composed of one barrel of cement to 7½ cu. ft. of sand and 15 cu. ft. of stone. The brick used is a hard burned pressed brick of a quality readily obtainable in the city of St. Louis. The work was done by the Fruin-Bambrick Construction Co., of St. Louis, Mo.

The second culvert was constructed to carry the water of the Harlem Creek through the freight yard at North St. Louis. Fig. 4 shows this culvert in process of construction. This creek originally wandered about the ground now occupied by the freight yards in a very crooked channel, and it was decided to make a new channel running directly across the yards. As the underlying rock is only from 20 ft. to 24 ft. beneath the surface of the ground, the brick walls were carried down to the solid rock foundation. These walls were built across the entire width of the yards for a distance of 1,560 ft., but the arch proper was carried only so far as the present track requirements made necessary. The height of the bench walls varied from 6 ft. to 11 ft. The arch has a span of 30 ft. and is made up of seven rings of brick. The face stone of the bench walls and the brick arch were laid in Portland cement mortar composed of one barrel of cement to 7½ cu. ft. of sand. The specifications for workmanship varied little from those usually required in ordinary first-class work of this character. The contractors for this culvert were Christie & Lowe, Chicago, Ill., and Mr. Geo. A. Lederle, M. Am. Soc. C. E., of that firm, was the Superintendent in charge.

The length of the arch at present constructed is 607 ft., and the total cost was $113,616. The unit prices were: Earthwork, 40 cts. per cu. yd.; concrete, $4.75 per cu. yd.; face stone, $12 per cu. yd.; brick masonry, $11.50 per cu. yd. The high price for excavation was due to the fact that it was in very wet soil and part of the material had to be handled with derricks. The price included also the back-filling over the arch and the distribution of the surplus material where it was needed to level up the yard.

The culverts were designed and constructed under the direction of Mr. Geo. S. Morison, Prest. Am. Soc. C. E., Chicago, Ill., who was Chief Engineer of the entire work of improvement. Mr. Benjamin L. Crosby, M. Am. Soc. C. E., St. Louis, Mo., was the Resident Engineer in charge of the work. We are indebted to Mr. Morison for the matter from which our illustrations and this description have been prepared.

THE POSSIBILITIES OF ELECTRICAL PUMPING MACHINERY.*

By Chas. A. Hague, M. Am. Soc. M. E.

The pumping of water by means of the power derived from the electric current has, as you are aware, already been accomplished upon a limited scale.

The convenience and controllability of electrical power, together with its simplicity of application to the work of pumping, commends it very strongly for use in isolated places, such as high service systems in public water supply, wherein a comparatively small percentage of the total water supplied by the initial plant is needed for dwellings situated upon levels too high to be accommodated by the general pressure; and the question of course arises whether we shall put the entire system of the city under the highest pressure required to force a supply to these higher levels, thereby placing a large portion of the mains and fixtures under an unnecessary strain, while operating under wasteful conditions of pumping power; or whether we shall isolate the higher levels and handle the smaller percentage of water by itself.

The application of electrical energy to the pumping of the main supply of a city of considerable size, although presenting many attractive features as far as the actual operation of the pumps is concerned, is not yet within the possibilities on account of the absence of inexpensive methods for producing the necessary current; so that, apparently, in pumping large quantities for some time to come, the compound, the triple, and the quadruple steam pumping engine will hold their sway. To-day it is beginning to offset very forcibly the proposition that it does not pay, in the present state of perfection of the steam engine, to go very far out of the way of regular commerce, to get the cheap power afforded by a falling stream.

To bring the problem of high-service pumping down to figures and familiar terms, supposing that a city's total supply is 10,000,000 gallons per day, and only 1,000,000 gallons are needed for a district which would make it necessary to deliver its supply under a pressure of 125 lbs. per sq. in. if delivered from the main pumping station; while the remaining 9,000,000 only needed a pressure of 75 lbs. for distribution. Then the difference in power would be as follows: The entire

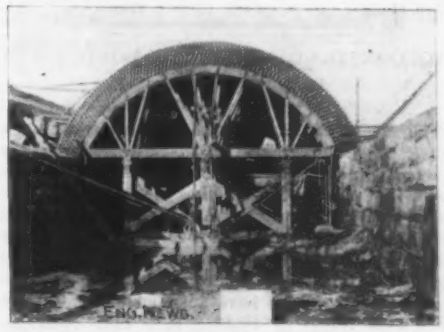

Fig 4. View of 30 ft. Span Arch Culvert over Harlem Creek, North St. Louis, Mo.

10,000,000 gallons under the 125 lbs. pressure represents 500 HP., while the 9,000,000 under 75 lbs. pressure represents only 270 HP.; and the 1,000,000 under the high-service pressure of 125 lbs. represents only 20 HP. The economy of power then would be 500 — (270 + 20) = 210 HP. saved by dividing the service.

How convenient it would be to generate an electric current at the main pumping station, with the boiler plant used for pumping the main water supply, then run the wires up to a point adapted to the high-service pumpage and operate an electrically driven pump. Of course, a high-service steam pumping plant could be installed at the proper point, but that would mean expensive attendance, hauling of coal, ashes and supplies; and last, although by no means least, large quantities of smoke and dust dispensed broadcast over what is generally a residence district. There are cities wherein pumping plants are supplied with anthracite

* Abstract of a paper read before the Atlanta meeting of the American Water-Works Association May 28-30, 1895.

coal at double the cost of bituminous coal, to quiet the complaints of dwellers, and the owners of lawns and trees.

Glance for a moment at the saving in fuel shown by dividing the service as set forth above. The case supposed is extreme, but extremes illustrate ideas forcibly, and there are probably cases in actual practice the full equal of the one supposed. Allowing that an economic duty of 100,000,000 is obtained at the pumping station, or, say, 2 lbs. of coal per HP.-hour; then the 210 HP. saved represents five tons of coal per day. This coal at, say, $3 per ton, represents $5,475 per annum, which would pay 5% interest upon $109,500.

Even if it should not be desirable to install an electric generating plant at the main pumping station, power could often be obtained from street railway, or lighting plants already in existence in many cities. When we consider the inconvenience and cost of sometimes providing mains for different districts, simply to convey the water supply from a central high-service pumping station, the possibility of a small electrical station for each district begins to hint at the economy in first cost and maintenance of such an electrical system.

The method of switching on and off the electric current by means of the water level or pressure is one of the details that will occur to the hydro-electrical engineer. In using this term, hydro-electrical engineer, I simply follow the tendency to specialize which has taken strong hold upon modern science and practice. At the start, the hydraulic engineer thought that there was nothing to do but harness up the electric dynamo and motor to a pump, and the task was accomplished of pumping by electricity. The electric engineers imagined there was nothing to do but harness up a pump to his motor, and behold, the result was obtained. But after a few attempts it was discovered that the pump handling such a stubborn and inelastic element as water was subject to inertia, shock, and variable power within short limits, quite at variance with the steady, uniform operation desirable for the best electrical results. The pump man turned his attention to securing a steadier flow of water, while the electrical man was, apparently, inclined to adopt the convenient but wasteful methods involved in the process of wasting power instead of controlling it. Hence the "hydro-electric" engineer, whose office is to reconcile the extremes of the case into the most benefit to all concerned, precisely in effect as the modern steam pumping engine designer has evolved a machine which, operated by a highly elastic fluid at one end, smoothly delivers an obstinate unyielding fluid at the other. If the steam pumping engine taking steam from the boiler at a pressure of 150 lbs., and sending this steam to the condenser at a pressure 8 lbs. below the atmosphere, can deliver without shock, and with a fairly close approach to theoretical economy, a steady stream of water, there is every reason to believe that the "hydro-electrical" engineer will eventually be able to bring the items of short circuiting, resistances, amperes and volts into a reasonably close approximation to the results demanded.

THE CONSTRUCTION OF THE BOSTON SUBWAY.

(With Inset.)

The city of Boston has probably a greater number of radiating electric street railways than any other city in the United States, and it is noted far and wide for the extent of its street railway accommodations. The very extent of such accommodation, however, has developed a very serious difficulty —namely, that with numerous radial lines converging on a few streets at the center of the city, some of the busiest streets have such an enormous and continuous traffic of electric cars that vehicular traffic is seriously interfered with, while pedestrians find it difficult and dangerous to cross the streets. The trouble is all the more serious from the fact that many of the streets in the congested district are narrow and crooked, and have a considerable traffic of heavy wagons and carts. These conditions, among others, have led to various propositions for underground and elevated railways, none of which, however desirable as a means of providing additional rapid transit facilities, seemed at all likely to relieve the congestion of traffic of the streets in question. The problem was not one of providing rapid transit for a distance, but of facilitating traffic upon certain existing and stated routes within a very small area (about 1 mile long and ¼ mile wide), as shown by the map in our issue of March 16, 1893. After much discussion of the matter, which was fully commented upon in our issues of March 16 and 23 and June 22, 1893, the Boston Transit Commission decided upon a subway system under certain streets, by means of which the electric cars will be diverted from the surface of the streets on some of the heaviest lines of travel, and will be run underground in a well-drained, ventilated and lighted tunnel, which will, of course, be free from the objections to underground railways where steam locomotives are used. It may be stated here that this solution of the problem has been persistently advocated in our columns, for reasons which were recited at length in the issues above referred to, and which need not be repeated here.

As shown by the map, Fig. 1, the subway is to commence at an underground station in front of the new terminal station of the Boston & Maine R. R. at Causeway St. The underground station has loop terminal tracks, and from the station two tracks extend along under Haverhill St., while two surface tracks on this street, which connect with the various surface lines converging at this point, begin to descend an open incline approach at Travers St., and reach the level of the other tracks at about Cross St., where the four-track section of the subway will commence, and a station with two island platforms will be built. The four-track subway will extend to near the commencement of Washington St., where it will branch off into two double-track sections, one under Cornhill and the other under Brattle St., which will converge again at a station under the open space at the junction of Tremont St. and Cornhill. From this station a double-track section will

Fig. 1. Map of Subway for Electric Cars, Boston, Mass.

extend under Tremont St. to a station at Park St., from which another four-track section will extend along Tremont St. (under the edge of the Boston Common) to a station at Boylston St. From this station the lines diverge, one double-track subway continuing under Tremont St. to Hollis St., and rising by an open incline to the street level at the junction of Tremont St. and Shawmut Ave., while the other double track turns to the right along Boylston St. (under the edge of the Common) to Park Square and Charles St., whence it rises by an open incline in the Public Gardens to reach the street level at Church St., opposite the Park Square terminal station of the New York, New Haven & Hartford R. R. At the Park St. station of the subway the terminal loop of one pair of tracks will be carried under the other tracks, and at the Boylston ton St. station one of the Tremont St. tracks is to be carried under one of the Boylston St. tracks, which it crosses, thus avoiding all track crossings at grade. There will be about 5,600 ft. of double-track subway, and about 3,500 ft. of four-track subway. The tunnel will be ventilated by means of fans driven by electric motors, and will be brilliantly lighted by electricity. The section now under contract comprises the open incline from Church St. to Charles St., the double-track subway under the Boylston St. mall of the Boston Common, and the four-track subway under the Tremont St. mall of the Common as far as a point opposite West St. This is the route as adopted by the Boston Transit Commission, of which Mr. Howard A Carson, M. Am. Soc. C. E., is Chief Engineer.

Borings were made along the route to an average depth of 25 ft., the maximum depth being 38 ft., and in most cases the material was easy to penetrate, including mainly earth, sand and gravel, and the indications were that the conditions for construction were fairly favorable. Water was met with in considerable quantities at some points, but it was not sufficient to indicate any serious difficulty. Some of these borings are shown on the sectional profile, Fig. 2. The borings were made by driving down a pipe and taking about twelve samples of the material at different depths by means of a small tube. The pipe was driven by a small portable pile driver, which also carried the tackle for raising the pipe, and the material within the pipe was washed out by a water jet. The grades are 3% and 5%, and changes of direction are made by curves of 700 ft. radius on the center line. Vertical curves connect the grades.

In general, the construction will consist of a concrete invert, side walls of steel columns with concrete filling between them, and a roof of plate girders or transverse I-beams, with brick jack arches between them and a covering of concrete. In the four-track section there will be a middle row of steel columns supporting the roof. In the open cuts of the approach inclines the retaining walls will be of concrete, with a facing of masonry in courses about 18 ins. high and 24 ins. thick, battering 1 in 12. The invert is also of concrete, and the invert and retaining walls of the inclines are to be founded on piles, with, in some cases, a grillage of 4-in. planks on transverse caps 10 × 10 ins. The width at rail level is 24 ft. 1 in. to 24 ft. 8 ins. These general sections are shown in Figs. 3, 4 and 5.

In Fig.6 are shown the plan and longitudinal section of the Charles St. end of the covered structure. Near the portal, and at certain other points, the roof is formed by I-beams 3 ft. apart, but mainly it is of plate girders 6 ft. apart. Where provision has to be made for carrying pipes across the subway, the jack arches are replaced by short cross-beams resting on the lower flanges of the roof girders, as shown in Fig. 6. Horizontal diagonal bracing connects the end roof girders, but is not required where I-beams are used. The vertical columns are spaced 6 ft. apart c. to c., and diagonal bracing is placed in each eighth panel or bay, as shown in Fig. 7, while double diagonal bracing is placed in each eighth bay of the middle line of columns, as shown in Fig. 10.

The cross-section of the double-track subway with I-beam roof is shown in Fig. 8, the clear width between columns being 24 ft., and the clear height above rail level being 14 ft. The concrete invert is 12 ins. thick, increased at the haunches, the upper surface having a radius of 61 ft. 3 ins., ending in a radius of 8 ft. 6 ins. at each side. The rail level is 2 ft. 6 ins. above the bottom of the invert. Along the middle of the invert is a tile drain in the concrete, built up with sides of brick and a covering of flagstones, manholes being provided at intervals. The vertical columns of the side walls are 15-in. I-beams, weighing 60 lbs. per ft., and these are, in general, 15 ft. high from the granite footstone to the underside of the roof beams. The greatest length is 17 ft. 6¾ ins., and where the length is greater than 16 ft. 5 ins. an 80 lb. beam is to be used. Between and behind these columns concrete is filled in to a thickness of 22 ins. at the columns, the thickness being decreased to 12 ins. midway between the columns, by recessing the face of the wall in a curve. The roof beams are 20-in. I-beams, 80 lbs. per ft., alternate beams resting on the columns and the intermediate beams secured by riveted connections to a longitudinal 15-in. channel iron, 40 lbs. per ft. On the side towards Boylston St. the concrete footing is carried out to an extra width, and at the tops of the columns are two 15-in. channels, weighing 40 lbs. per ft., on which and on the columns rest the transverse roof beams, as shown on the right hand of Fig. 8. The roof beams are connected at the middle of the span by a line of web plates ½ × 18 ins., secured by vertical angle iron connections riveted to the plate and the webs of the beams, an expansion joint being provided at every eighth panel. Knee bracing is provided at the upper corners of each bent of the ironwork, con-

sisting of two angle irons ⅝ × 3 × 3½ ins. riveted to angle plates, this bracing connecting the columns and roof beam. The brick jack arches of 3 ft. span, are domed, as shown, the crown being on a curve transverse to the subway, while the haunches are level, the arches having thus a flat radius at the sides and a sharper radius at the middle of the subway.

Where the roof is of plate girders with jack arches of 6 ft. span, the construction is as shown in Fig. 9, the longitudinal channels at the tops of the columns being replaced by a single outside longitudinal angle iron. Vertical diagonal bracing is placed between the ends of every second pair of girders, as shown. The girders are composed of four chord angles ⅝ × 4 × 6 ins., and a web plate ½ × 30 ins. With this construction the longitudinal connecting web at the middle of the roof is dispensed with. An expansion joint is provided for the longitudinal channels of the I-beam roof, and the exterior longitudinal angle iron of the girder roof, at every fourth column, the joint being made with slotted holes 15-16 × 1 7-16 ins. and 15-16-in. turned bolts.

On the four-track section the invert, side walls and roof are of the same construction as shown on the left-hand side of Fig. 8, but the middle of the roof is supplied by columns 14 ft. high of I-section, built up of four flange angle irons ⅝ × 3 × 4 ins., and a web plate ½ × 10 ins. On top of these columns rest two lines of longitudinal 12-in. I-beams, 45 lbs. per ft., having expansion joints over every fourth column. Double diagonal bracing is placed in every eighth panel, as shown in Fig. 10.

The middle drain is of 12-in. Akron half-pipe laid in Portland cement mortar, and its side walls are of brick, laid as headers, each course being thinly plastered after laying, and the side joints being without mortar. Manholes are placed at intervals. Side drain pipes are to be placed where necessary outside the footings of the side walls in the subway, approximately as shown in Fig. 8, the size and elevation being determined by the engineer as the work progresses. A pump well is to be built near the foot of the approach grade.

The ventilating chamber for the double-track section, shown in Fig. 11, is nearly opposite the Public Library, on Boylston St. It is a concrete chamber about 13 ft. wide and 12 ft. long, with a 6-ft. opening into the tunnel fitted with a ventilating fan driven by an electric motor, the air exhausted being discharged through an air duct 6 ft. 6 ins. diameter. The ventilating chamber for the four-track section is near West St., and is a segmental chamber having two fans in separate compartments drawing air from the tunnel through 6 ft. openings, and discharging it through a duct 11 ft. 6 ins. in diameter. The fans and motors will be furnished and put in place by the commission.

In the construction of the work all surface materials within the limits of the trench (including pavements, paving gravel, broken stone, etc.) are to be removed in advance of the trench excavation, and kept separate for use in resurfacing and repaving. The trench or tunnel excavation is to be of such capacity as to give room for the proper construction of the subway, for plastering and coating the interior, and for all the necessary bracing, the exterior sheeting and bracing being so arranged that it can be removed as fast as each thin stratum of backfilling is put in, except when it cannot be removed without injury to the work. The length of trench opened or surface disturbed at any one time is to be no greater than is necessary for vigorous and economical prosecution of the work. Unless otherwise permitted, the contractor is to carry on the work in such a way as to leave as large a core or dumpling of the excavation as practicable, this core being taken out after the walls and roof have been constructed and the surface of the ground restored approximately to its former condition. The engineer may require a large portion of the carting away of surplus material not needed for backfilling, to be done between 6 p. m. and 8 a. m. Rock excavation will include only stones of ½ cu. yd. or more, and such ledge or rock as requires blasting. Blasts in the trench are to be covered with heavy timbers chained together, and caps or other exploders are not to be kept in the same place in which dynamite or other explosives are stored. No sewers, drains, water or gas pipes, electric conduits, etc., may be moved without the consent of the engineer, and in all cases the respective services must be maintained. Excavations below the subway grade are to be refilled with gravel in thin layers, thoroughly wetted and rammed, or with concrete or other masonry, and where piling is used the ground must be filled in level with the timber platform built upon the piles. The backfilling is to be done in layers not more than 6 ins. thick, well watered and thoroughly rammed, or thrown into the trench and allowed to settle into place through a suitable depth of water.

Portland cement and American natural hydraulic cement will be used, all fine ground and of good weight, the Portland cement being equal to the best of the "Dyckerhoff" brand, and the American cement being fresh and equal to the best of the "F. O. Norton" brand. All mortar will be composed of cement, and clean, coarse, sharp sand, in the following proportions, by measure: Portland cement mortar, 1 part cement to 2 parts sand; American cement mortar for brick masonry, 1 cement to 1½ sand; American cement mortar for stone masonry and in concrete, 1 cement to 2 sand. A moderate dose of water is to be afterwards added to produce a paste of proper consistency, the whole to be thoroughly worked with tools or machinery.

Concrete is to be composed of the above mortar mixed with perfectly clean screened gravel, consisting of pebbles or fragments not exceeding 2 ins. diameter, only 5% less than ¼ in., and the remainder of various sizes from ¼ in. to 2 ins. The concrete mixture must contain 1 measure of cement to 2 of sand, and not more than 4½ of gravel. The mixing must be continued until no particle of gravel can be found that is not covered with mortar, and after the materials are wet the work must proceed rapidly until the concrete is in place and is so thoroughly rammed that water flushes to the surface, and all the interstices between the stones are entirely filled with mortar.

In brick masonry the face joints are not to exceed ⅜-in. for the beds and ½-in. for the ends. The bricks are to be thoroughly wet before laying, and every brick must be completely embedded in mortar on its bottom, side and end at one operation. Unfinished work must be racked back or toothed, and when new work is joined to it, the bricks must be scraped, thoroughly cleaned by scrubbing with a stiff brush and well moistened. Squared stone masonry is to be of granite of compact texture, free from loose seams and other defects, and laid on its natural bed, the bed and joints being well filled with mortar. Each stone to be from 17 to 18 ins. high, with its thickness equal to that of the wall (but not exceeding 3 ft. 6 ins.), and with no recess more than 2 ins. deep on the back, sides or bed, or 1 in. on the face. The length of the face of the stone is to be from 1 ft. 6 ins. to 8 ft. The stones for the side walls of the inclined entrance to the subway are to be rectangular blocks of Quincy, Cape Ann, or equally good granite, from one-fourth to one-third of the face stones being headers, uniformly distributed, and not less than 2 ft. wide and 4 ft. long. The stretchers may vary in length from 4 ft. to 7 ft., and must be from 20 to 26 ins. deep. The courses are to be 18 ins. high with vertical end joints and horizontal bed joints the whole length of the wall, the joints being filled with Portland cement mortar, and no part of any face joint exceeding ½ in. in width. The faces are to show no drill marks, and to have no projections of over 2 ins. and no recesses below the plane of the arrises. The coping stones are to be not less than 4 ft. long, with exposed surfaces rough-pointed, and will be laid in Portland cement mortar. All face joints are to be raked out to a depth of 1 in. and properly pointed. The granite footing stones for the columns are to be rough-pointed on top, bottom and beveled sides, laid in Portland cement mortar and set somewhat high, the tops being finally dressed with hammers, so as to form accurate seats for the bases of the columns. The anchor bolts will be secured in the holes in these stones with neat Portland cement mortar.

All work is required to be watertight, and any leaks discovered after the work is completed must be stopped. When work is done in freezing weather the contractor is to heat the bricks, gravel, sand and water, and he must thoroughly protect the masonry from damage by rain and frost during and after laying. No work is to be done on such days as the engineer may consider that good work cannot be done.

Piles are to be spruce sticks, not less than 6 ins. diameter at the small ends, and the caps and platforms will also be of spruce, the caps being fastened to the piles by ¾-in. drift bolts 8 ins. longer than the thickness of the cap.

The contractor for the construction is to set in place all the columns, girders, cast iron brackets and all metal work. All riveting, drilling or punching in the steel and ironwork that is practicable before the same is placed in the subway will be done by the commission, but the contractor must do all riveting, bolting and other work necessary to connect the members and to secure them to the masonry. The bases of all columns will be set in neat Portland cement mortar. The rivets will be furnished by the commission, and must be properly heated just before being driven, thoroughly upset in driving and have full, well-shaped concentric heads. All contact surfaces must be painted before assembling, and all parts will receive two coats of paint after erection, no painting being allowed during wet or freezing weather, and the second coat not being applied until the first is thoroughly dry. Where the subway is on a grade, the columns and roof girders must be kept vertical, the necessary variations being made in the bracing, and where necessary tapered shims will be used between the columns and girders.

All the metal work (except the shoe plates, separators and brackets, which may be of iron) will be of open-hearth or Bessemer medium-grade steel, with not more than 0.06% of phosphorus or sulphur, or 0.9% of manganese. Test pieces must show an ultimate strength of 60,000 to 68,000 lbs. per sq. in., an elastic limit not less than half the ultimate strength, a minimum elongation of 20% in 8 ins., and a reduction in area of not less than 40% at the point of fracture. They must bend cold 180° to a diameter equal to the thickness of the test piece, without showing any sign of fracture on the convex side. Rivet steel must have an ultimate strength of 52,000 to 60,000 lbs. per sq. in.; an elastic limit not less than half the ultimate strength; a minimum elongation of 26% in 8 ins., and a reduction in area of 50% at the point of fracture. It must bend cold 180° flat on itself without showing sign of fracture, and when quenched from a low, cherry-red heat in water at 70° F., must bend 180° around a diameter equal to the thickness of the piece without cracking.

All columns are to be faced square at both ends after the knees have been riveted to them, in order to secure accurate contact with the horizontal plates. All uprights on the girders which extend over the flange or chord angle irons must be made to fit closely to the horizontal legs of both angles. Rivets are to be machine-driven wherever possible. In punching, the diameter of the punch must not exceed that of the rivet by more than 1-16 in., and all holes must be clean cuts, sharp fins being trimmed off before riveting. All rivet holes in steel more than ½ in. thick must be punched with a die whose diameter is ⅛ in. less than that of the rivet, the hole being then reamed to a diameter 1-16 in. greater than that of the rivet. Holes must be accurately spaced so that the rivets can be easily inserted without straining the metal.

When the subway is constructed the columns may be set and connected with masonry before the transverse roof beams and girders are placed, and it is therefore necessary that the holes in the beams and girders required for the connections, shall be placed with great accuracy, no error greater than 1-32 in. being allowed. Great care must be taken in handling the steel, and the straightening after punching must be so conducted as to reduce the risk of cracking to a minimum. Steel sections must not be hammered cold or worked at a black heat, and when any part of a steel plate or section has to be heated for working, the whole must be afterwards annealed. All surfaces which will be inaccessible after assembling must be well painted with the best red-lead before being put together, and before leaving the shop the whole is to receive one coat of the same.

The contract for the iron and steel work has been awarded to the Pennsylvania Steel Co., of Steelton, Pa., and the contract for construction has

been awarded to Jones & Meehan, of Jamaica Plain, Mass., at $136,602, and the detail prices of this contract were given in our issue of March 28. The price for the iron and steel work is $39.32 per ton of 2,000 lbs., and as about 1,000 tons will be required the total price will be $39,320, making a grand total of $175,923 for this section of the work. The cost of the entire subway, exclusive of land damages, is estimated at about $4,000,000, and real estate and land damages are estimated to amount to about $1,000,000 more, or $5,000,000 in all.

THE CONSTRUCTION OF FORT ETHAN ALLEN, NEAR BURLINGTON, VT.

By J. M. Evans and F. G. Cudworth.

Fort Ethan Allen is situated about four miles from Burlington, Vt. The preliminary survey of the ground was made in the fall of 1892 and the early winter of 1893. At that time nearly all of the 600 acres now embraced in the reservation was covered with a second growth of timber and small brushwood. About half of the tract is now cleared and laid out in parade and drill grounds and building sites. The buildings now completed are 26 in number, and others are in the process of erection.

The original plan contemplated buildings sufficient for an eight-company post; about half of the original number have been completed, and at present four troops of cavalry are stationed there. Capt. Guy Howard, A. Q. M., U. S. A., was the constructing officer in charge. The principal buildings are, four double sets of officers' quarters, two double sets of barracks, hospital, bakery, storehouses, cavalry stables, pump house and water tower.

The first contracts were let April 7, 1893, and called for a number of buildings, sewers, roads, gutters, walks and the water system.

From an engineering standpoint, probably the most interesting part of the work is the water system. It consists of two deep wells, a pumping plant, a steel stand-pipe 12 ft. in diameter and 62 ft. high, 7,800 ft. of 6-in. pipe, 1,430 ft. of 4-in. pipe, the distributing pipe being laid in the form of a loop, to give circulation throughout the system, and 20 Matthews double fire hydrants.

Water is furnished from two wells, No. 1 being 6 ins. in diameter and 386 ft. deep, and No. 2 being 8 ins. in diameter and 356 ft. deep. The wells are 200 ft. apart. In No. 1, 183 ft. of casing was used before strking bedrock. In No. 2, 247 ft. of casing was used. This shows a very abrupt profile of the underlying strata. The soil through which the wells were driven is mostly sand, though some gravel and quicksand were encountered. An experimental well was driven at an expense of $500, but no water was obtained. The contract price for the wells, including the experimental well, was $8,000. The capacity of the wells is about 144,000 gallons per 24 hours—some 20,000 gallons more than called for by the contract.

The specifications for the pumping plant calls for the following machinery: A 60-HP. horizontal tubular boiler; a feed pump; Pohle air-lift pump, to operate two artesian wells, delivering water into a cistern in the pump house; one straight-line air compressor, made by the Rand Drill Co., or equally as good, 12 × 12×16 ins.; a 2 × 8 ft. air receiver tested to 200 lbs.; one Knowles improved duplex pump, or as good, capable of delivering from 200 to 400 gallons per minute to an 80-ft. tower.

The most attractive feature of the system is the water tower, Fig. 1, built of "Proctor marble," rock-faced, random ashlar in courses varying from 12 ins. at the bottom to 8 towards the top. The tower is circular, 25 ft. in diameter at the water table, decreasing to 21 ft. at the top, batter being all on the outside.

At the water table the walls are 4 ft. thick, and at the balcony they are 2 ft. The foundation was excavated 10 ft. below grade and filled in with masonry and concrete. There are 48 cu. yds. of concrete and 214 cu. yds. of masonry below the water table; 415 cu. yds. of masonry from the top of water table to landing, not including the cut ashler, of which there are 4,600 sq. ft. The total height of the tower from grade line to apex of roof is 96 ft. The stand-pipe is 12 ft. in diameter and 62 ft. high. The base was set and leveled on a course of Portland cement mortar.

The tank metal is a soft, homogeneous steel, possessing a maximum tensile strength of 60,000 lbs., with a limit of variation of 5,000 lbs. All sheets were of uniform size, truly and evenly rolled, and sufficiently ductile to admit of rolling while cold

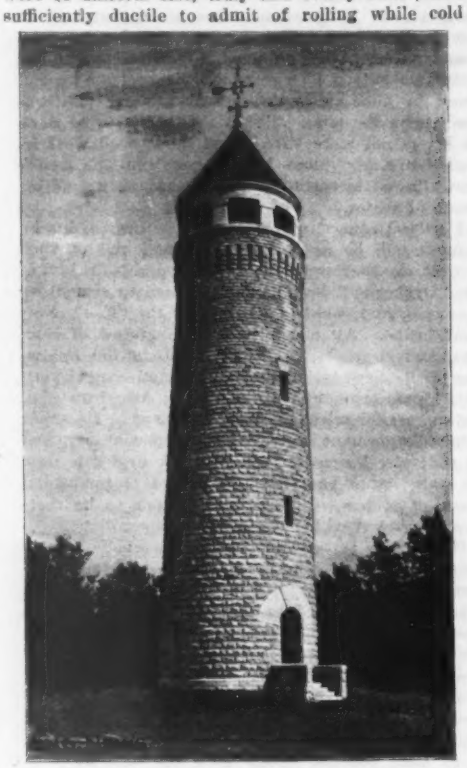

Fig. 1. View of Water Tower, Fort Ethan Allen, near Burlington, Vt.

around a radius of 20 ins. without developing flaws or cracks.

The plates were placed in position and riveted course by course after the stone work of tower was up. They decrease in thickness from 7-16 in. at the bottom to 3-16 in. at the top. The diameter of the rivet is ⅞ to ⅝ in.

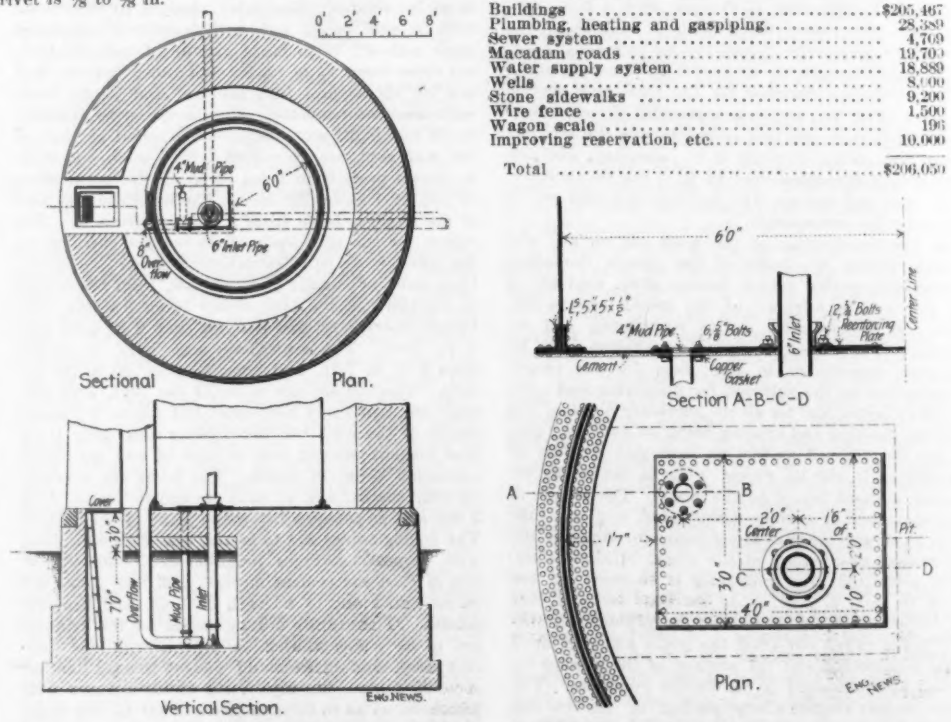

FIG. 2. DETAILS OF WATER TOWER, FORT ETHAN ALLEN.

At the base of the tower is the usual valve chamber, as shown in Fig. 2. The 6-in. inlet pipe passes through a sleeve, as shown in Fig. 2, having a recessed bell with a poured lead joint, which admits the pipe slipping in case of settlement. The mud-pipe is riveted to the bottom of the stand-pipe, and connects with a 9-in. drain leading to a ravine, as does the 8-in. overflow pipe from the top of the tank. An iron stairway gives access to the balcony.

The cost of the tower and stand-pipe was $12,000, of which the stone work cost $9,000; stand-pipe, $2,500 and the stair and door hardware $500. The hardware for the door is of rustless iron (Bower & Barff) finish, costing $76. Both tower and stand-pipe are of the best material and workmanship, and were erected by Zeigler & Dalton, of Junction City, Kan.

The cost of trenching, laying and back-filling the water pipe was 11 cts. per foot. The pipe was laid at an average depth of 5 ft. The contract price of the water system complete was $18,889. The sewerage system consists of 6,825 ft. 6-in. vitrified pipe, laid at a depth varying from 3 to 14 ft.; three Van Vranken automatic flush tanks; 13 manholes and connections complete. The minimum grade of the sewers is 5, and the maximum 38½ ft. in 100. This heavy grade is caused by a difference of 150 ft. in elevation between the site of the fort and low water mark of the Winooski River, where the outlet of the sewer is located. The contract price for the sewers was 69 cts. per ft.

The roads are of macadam, with cobblestone gutters. There are 6,600 ft. of roadway 30 ft. wide, and 2,700 ft. 20 ft. wide. The construction, including catch-basins, gutters, etc., cost $10,850 per mile. The road material is the hardest kind of limestone. The haul from the quarry was about 1½ miles. As completed by the specifications, the roads had not a good wearing surface, owing to the lack of binding material in the top cover. Since the completion of the contract from ½ to 1 in. of gravelly loam has been added at a cost of $30 per mile, and has produced a fairly good wearing surface.

The sidewalks are Hudson River bluestone laid on a sand-bed. There are 5,667 ft. of 5, and 2,730 ft. of 4 ft. The 5-ft. walk is 3 ins. thick, and was laid for $1.30 per lin. ft. The 4-ft. walk is 2½ ins. thick, and was laid for $1.02 per lin. ft.

In the central portion of the reservation is located the rifle butts; the rifle range, as shown on the map, is 1,000 yds. long and 210 ft. wide. This was built at a cost of $2,500.

The total amount of money expended in buildings thus far is about $250,000, of which $206,050 is accounted for as follows:

Buildings	$205,467
Plumbing, heating and gaspiping	28,389
Sewer system	4,769
Macadam roads	19,700
Water supply system	18,889
Wells	8,000
Stone sidewalks	9,200
Wire fence	1,500
Wagon scale	196
Improving reservation, etc.	10,000
Total	$206,050

An important patent suit involving the "under running trolley" of electric railways is now being tried at New Haven, Conn., the suit being that of the Thomson-Houston Electric Co. against the Winchester Ave. Ry. Co., and being practically a contest between the General Electric Co. and the Westinghouse Electric & Mfg. Co.

THE COMPARATIVE ADHESIVE AND COHESIVE STRENGTH OF CEMENT.

In publishing the prize thesis by Messrs. Affelder and Brown, on p. 333 of our last issue, Table II., which should have accompanied the article, was omitted by an error in the make-up. The table explains itself; the figures in the next to the last column were obtained by dividing the average unit tensile strength by the average adhesion. For the sake of completeness, we reprint herewith the conclusions reached by the author from the figures given in the table:

(1) That the coefficient expressing the relation between cohesion and adhesion is a rather uncertain quantity, varying with the age and quality of the cement;

(2) That it may be greater or less than unity, its highest limit being about 5;

(3) That if materials of nearly equal porosity are cemented together, the coefficient cannot be said to vary directly with that property;

(4) That the coefficient is greater for Portland cement than for natural cements;

(5) That in the case of Portland cements it varies from about 1.5 to 5.0, and natural cement from 0.5 to 4.5;

(6) That with Portland and natural cements alike, the coefficient decreases with the age;

(7) That the coefficient of natural cements decreases more quickly than that of Portland cements;

(8) That a cement poor in cohesion may be high in adhesion;

(9) That, without doubt, the adhesion in time will equal and even exceed the cohesion.

TABLE II.—Showing Tensile Strength of Four Different Kinds of Cements Compared with the Adhesion of the Same Cements to Hard and Soft Red Brick and to Fire Brick.
(F. = fire brick; H. = hard red brick; S. = soft red brick.)

Cement.	Age, days.	Per cent. by weight. Cement.	Per cent. by weight. Water.	Tensile strength, lbs. per sq. in. No. tested.	Tensile strength, lbs. per sq. in. Highest.	Tensile strength, lbs. per sq. in. Lowest.	Tensile strength, lbs. per sq. in. Average.	Adhesion, lbs. per sq. in. No. tested.	Adhesion, lbs. per sq. in. Highest.	Adhesion, lbs. per sq. in. Lowest.	Adhesion, lbs. per sq. in. Average.	Relation of tension to adhesion.	Temp. of room, degrees Fahr.
Germania ....F.	14	77.04	22.96	3	415	414	414	3	106	106	136	3.044	59
" .....S.	14	75.80	24.20	5	430	320	352	4	93	75	89	3.955	65
" .....H.	14	75.84	24.16	5	452	301	357	4	162	74	109	3.275	65
Giant .....F.	14	77.46	22.54	5	381	311	346	4	182	169	175	1.977	62
" .....S.	14	76.76	23.24	6	386	280	321	3	107	107	107	3.000	64
" .....H.	14	76.58	23.42	6	433	250	358	3	255	169	220	1.627	65
Union .....F.	14	74.35	26.65	6	96	53	83	3	64	27	48	1.729	62
" .....S.	14	73.61	26.39	5	133	44	106	2	36	36	36	2.944	64
" .....H.	14	74.06	25.94	6	123	89	103	3	39	30	35	2.943	65
Hoffman .....F.	14	73.82	26.18	6	156	128	145	4	48	38	36	4.028	64
" .....S.	14	73.36	26.64	6	106	83	95	4	51	40	44	2.159	62
" .....H.	14	73.40	26.51	6	62	35	57	4	45	25	34	1.676	65
Germania .....F.	21	76.47	23.53	5	440	368	426	3	145	73	116	3.672	64
" .....S.	21	76.33	23.67	5	408	297	333	4	141	116	124	2.685	65
" .....H.	21	75.98	24.02	5	433	348	402	2	124	60	92	4.369	70
Giant .....F.	21	77.67	22.33	6	425	293	342	2	205	72	139	2.460	64
" .....S.	21	78.19	21.81	5	522	289	394	2	335	149	242	1.628	65
" .....H.	21	77.21	22.79	6	379	353	368	3	248	232	240	1.533	65
Union .....F.	21	74.15	25.85	6	107	94	101	4	72	62	68	1.485	64
" .....S.	21	74.29	27.71	6	132	104	115	3	48	41	45	2.555	65
" .....H.	21	74.30	25.70	6	110	99	106	4	43	40	42	2.524	68
Hoffman .....F.	21	73.18	26.82	5	95	88	91	3	59	32	46	1.978	60
" .....S.	21	72.98	27.02	6	108	78	95	3	56	51	54	1.759	66
" .....H.	21	73.00	27.00	5	101	72	89	4	68	59	65	1.369	68
Germania ....F.	28	72.62	27.38	5	406	283	330	2	168	139	154	2.201	58
" ....S.	28	75.46	24.54	4	381	297	335	3	200	172	191	1.734	57
" ....H.	28	75.95	24.05	6	443	391	413	3	187	180	184	2.245	57
Giant .....F.	28	78.30	21.70	4	480	384	429	4	170	87	123	3.488	58
" .....S.	28	77.71	22.39	5	433	268	347	3	158	91	122	2.844	57
" .....H.	28	77.39	22.61	5	442	288	361	4	260	123	181	1.999	57
Union .....F.	28	74.36	25.64	5	111	76	97	3	167	96	143	0.679	58
" .....H.	28	74.29	25.71	6	141	100	122	4	151	89	130	0.938	57
" .....S.	28	74.03	25.27	6	130	96	114	3	207	80	145	0.786	57
Hoffman .....F.	28	72.75	27.25	5	106	71	88	4	123	51	79	1.114	58
" .....S.	28	73.18	26.82	6	151	84	112	4	98	53	69	1.623	58
" .....H.	28	72.48	27.52	6	136	117	123	7	135	71	101	1.218	59

PRACTICAL EXPERIENCE WITH A WATER-METER SYSTEM.*

By John B. Newhall.**

Before being put in actual service all meters should be tested. The following method has been adopted by our company with successful results: The meter is first subjected to a pressure of 100 lbs. for leakage. If the stuffing box leaks, care should be taken in tightening that the spindle does not become bound, thus making the meter run lazily when under a small stream. Next a small quantity of water should be run through to make sure that all the parts are lubricated. After this 5 cu. ft. of water should be passed at the maximum rated capacity, then the same amount at lesser rates, until finally a 1-32-in. stream is used. Small meters should be overhauled once in two years.

The meters are owned by the company and their cost is charged to construction. It was felt that the meter ought to be placed upon the services without any expense or inconvenience to the consumer, as it would be enough to impose meter restrictions. This gives the company jurisdiction and does away with much friction. This method is happily prevailing elsewhere.

Meters should be read monthly and manufacturers' bills rendered at the end of each month and other bills quarterly. This serves as an inspection, and when unduly large readings are noted the proper persons are notified. This course has won the company many friends.

Our contract does not allow a minimum meter charge, but fixes a flat rate of 50 cts. 1,000 gallons. A two years' trial has shown that a minimum charge and a nominal rate are preferable to a high rate alone; the former plan permits the metering of every service, but under the latter naturally only the larger consumers are metered, and the small consumers, having no restrictions, use proportionally more water than the large one, and thus injustice is done to the latter.

At present 1,000 of our 1,900 services are metered. It would be better to meter all if we could make a minimum charge, regardless of the smallness of the consumption.

A good meter system would be beneficial to any plant. It was especially necessary for our company, as we are located on an island and draw water from driven wells on expensive land. In the spring of 1892, the directors were forced either to curtail waste or enlarge the plant. Meters were adopted and the per capita consumption cut down at least 50% without affecting the revenue, while in addition the fire service has been improved. The enlargement of the plant has thus been put off until the growth of the place really demands it.

The Chinese laundryman will bear watching. He does not like the "clock," as he calls the meter. He has discovered that the meter will not register a drop-by-drop flow, and he puts this knowledge to practical use. Some housewives boast of like economies. Still another way of evading large water charges is by drawing water through the stop and waste cock of the meter. We avoid this by substituting for an ordinary Newport cock a compression stop, which does not waste until entirely closed.

It is difficult to make consumers understand that a leak, however small, is, like interest, remorseless, and owing to increased pressure is greatest at night. You will not doubt that I believe in meters, but I may give this warning to those superintendents starting a flat rate meter system in a town where people have been allowed previously to waste all the water they possibly could: They should be provided with not only a good stock of patience, but a coat of mail as a protection against the stings and arrows of incensed consumers. Let them be assured, however, that if they succeed, and succeed they must, the water board or directors of the company, the fire department, and finally the consumers, will rise up and call them blessed.

* Abstract of a paper read before the Atlanta meeting of the American Water-Works Association, May 28-30.

** Superintendent of the Crystal Water Co., Edgewater, Staten Island, N. Y.

PROPOSED EXTENSION OF ASPHALT PAVING IN NEW YORK CITY.

A report on the advisable expenditure for asphalt paving during the current year has been made to Mr. William Brookfield, Commissioner of Public Works, by Mr. E. P. North, M. Am. Soc. C. E., Water Purveyor. The paving recommended aggregates 195,025 sq. yds., at an estimated cost of $780,000, and is mainly in the poorer and more densely populated portions of the city, and on streets that are likely to become great thoroughfares.

The report states that over 63% of the pavements relaid since and including 1889 have been of granite or trap blocks, and rather less than 37% of asphalt. Of the 1,196,079 sq. yds. of asphalt pavement now laid in the city, between 60 and 70% has been laid in the area bounded by Fourth St., Third Ave., Seventh Ave., 59th St. and the Hudson River, which boundaries approximately include the wealthier residence districts. Most of the asphalt paving in this region has been laid in short lengths, which do not average, in the cross streets, a block and a half long; there being over 60 separate pieces a full block or less in length. Some of these are without connection with other asphalted streets, so that much of the work done in this area has been a matter of luxury and convenience to those living on such streets, and is not calculated to appreciably affect either the death rate or the general health of the city; and its utility, where it cannot be incorporated in a general scheme, is practically confined to the immediate vicinity in which it is laid.

In the project now submitted, the only region favored is that occupied by the wage-earning population, and the principle has been to continue the very necessary work of asphalting the streets in the overcrowded districts east of the Bowery. In addition to this, streets have been selected for asphalt pavement that will extend the present lines of transportation and open routes across the city, which will cheapen the delivery of goods and give comfortable access to some of the more important ferries. All of the proposed pavements are on streets that require repaving. About 2.4% is south of Chambers St., in the business part of the city; 40.7% in regions east of Center St. and south of First St., and 57% is devoted to through routes. Of this only 22.3% is in that division of the city which contains between 60 and 70% of the asphalt now laid, so that, in fact, 84.7% of the proposed new work will be in the lower parts of the city, where it is most needed for sanitary purposes.

Mr. North states that the replacing of the worn-out stone pavements with asphalt laid on them presents the most economical solution of a very serious problem. The cost of a granite pavement laid on concrete averaged last year $3.14 per sq. yd., while asphalt pavement averaged $3.80, but this cost included keeping such pavements in repair for 15 years, and turning over to the city a good pavement at the end of that period. The granite pavements, on the other hand, were only guaranteed for six months, and under the heavy traffic of Broadway the granite pavement has become badly dilapidated in three years. It seems therefore, that there will be an economy in replacing the worn-out pavements with asphalt, both in the matter of ultimate cost and the greatly reduced cost of street sweeping (about twice as much being now appropriated for cleaning as for repaving streets).

It is, however, as a sanitary appliance that asphalt pavement presents the greatest value, being nearly non-absorbent, and free from cracks that offer lurking places for disease germs, while it can be thoroughly washed. It is thought there will be no substantial objection to increasing the area covered with such easily-cleaned pavements in the more thickly populated districts. Persons living in tenement houses are often uninformed as to the value of cleanly surroundings. Their children spend a large part of their time on the pavements, and during the hot nights of summer the whole family pass the evening there. In such cases, where stone pavements are habitually greasy, the menace to infant and adult life must be a very serious one. In addition to the easily ascertained bills of mortality resulting from unsanitary surroundings, there is an unknown and often unrecognized loss from sickness. Where that strikes the bread-winner, particularly in the districts under consideration, the result is apt to be pinching want and hunger.

It has been argued that asphalt paving should first be laid around the public schools, but it has been ascertained that this alone would involve an expenditure of $1,000,000. Mr. North says that the claims of householders and business men, of urged with unanimity, would receive immediate attention with the funds necessary to satisfy their desires, but it is only the inhabitants of the tenement houses that lack means for organization and effective representation, and he thinks that their necessities should be attended to before other interests are satisfied. With this idea we entirely agree, as good and easily cleaned pavements in the poorer and more densely populated streets will undoubtedly largely conduce to the general health and the suppression of disease. It is confidently expected that increased competition between those laying asphalt pavements will result in reduced cost to the city.

A new eight-wheel express locomotive recently built at the Altoona shops of the Pennsylvania R. R. has driving wheels 6 ft. 8 ins. diameter and cylinders 18½ × 26 ins. The boiler is 5 ft. 8 ins. diameter inside the smallest ring, and has 310 tubes 1¾ ins. diameter. The engine is very similar to the class P engine illustrated in our issue of Jan. 17, but the latter has cylinders 19 × 24 ins. and a smaller boiler.

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We show on our inset sheet this week, and describe in another column, one of the most interesting engineering works now in progress anywhere—the subway for electric street car traffic in Boston, Mass. The feature of most interest to engineers in connection with this work is doubtless the elimination of the retaining wall. Instead of building a massive masonry wall on each side of the subway the engineers have built a wall of steel and concrete. I-beams 15 ins. in depth, spaced 6 ft. apart, form the skeleton of the wall, which is completed by concrete arches turned between them. The superiority of such a wall to the ordinary retaining wall, which resists by weight alone the pressure of the material behind it, is evident. The load to be carried by the foundations is much reduced, the width of excavation necessary is decreased, and we have the enormous strength of the roof and invert to take up the pressure of the earth behind the wall. The heavy I-beams, with the overhead knee braces, give the wall abundant strength against strains tending to bulge it at the center. In short, it is the sort of structure which an engineer can design and build with entire confidence that it will stay in place; whereas abundant experience with retaining walls of the ordinary type has shown that an element of uncertainty is always present, and not infrequently a wall built with the most careful attention to design and construction will fail before one erected in defiance of all rules and precedents.

It is worth noting that this substitution of steel for masonry is, to a certain extent, made possible by the great drop in steel prices which has taken place during the past few years. About 1,000 tons of steel were used on Section I. of the subway, and the contract price was only $39.32 per ton of 2,000 lbs., or 1.866 cts. per lb. On the other hand, it appears that the cost of the metal structure is after all a small proportion of the total cost. The steel for Section I. will cost, by the above figures, less than $40,000, and while there is probably a smaller amount of steel on this section than on the others, on account of its containing one of the approaches, the cost of the steel for the whole work will not, we believe, exceed 10 per cent. of the total cost.

The cost of the entire subway, exclusive of land damages, is estimated at about $4,000,000. Another million is added for real estate and land damages. There will be in the whole work about 5,600 lin. ft. of two-track subway, and about 3,500 ft. of four-track subway. The total track in the subway will thus amount to 25,200 ft., and at the above figure of $4,000,000, the cost for construction alone will be $158 per lin. ft. of track, or at the rate of $834,240 per mile of single track.

The interest of the subway as an entirely new departure in solving the problem of overcrowded city streets, and an instance of an important work being carried out by the municipal authorities, is very great; but these aspects have already been fully explained in previous issues of this journal.

The Board of Direction of the American Society of Civil Engineers has issued a circular pointing out to the members the need of better accommodations for the Society and its archives. The present building, transformed from an old-fashioned New York dwelling, is altogether inadequate and unsuitable for the purposes of the Society; and its rapidly accumulating and valuable library and records are insecure in a building of this character. Taken in connection with the existing resources of the Society, the estimated expenditure for a new Society house is not a large one, and the amount required should be easily raised from among the members. The standing of the Society and its further development as an organization for the advancement of engineering interests in this country both warrant and demand more ample quarters, and the adoption of the best means for furthering this development. It is a needed improvement, and would more emphatically mark the healthy growth of the Society in numbers and importance than any other step that could be taken. It is to be hoped that the membership will fully appreciate the mutual value of such an improvement, and will be prepared, at the next annual convention, to give a favorable expression to their views.

The confusion existing in the use of the long and short ton in mining and shipping coal in this country is one of many arguments in favor of a thorough revision of our present system of weights and measures. Anthracite coal is always sold by the long ton of 2,240 lbs., and Maryland law compels the use of the same ton in mining and shipping all coal. Bituminous coal mined in Pennsylvania and West Virginia, and sent East in competition with Maryland coal, is also sold by the long ton. But in nearly every other case the short ton of 2,000 lbs. is used. Coal is produced in greater or less quantity in 28 states, covering a belt practically extending from Virginia to California; and while the product sold by the long ton includes about 60 per cent. of the total, the other 40 per cent. is measured by a ton of a very different value. There seems to be no valid reason for this difference in tons, other than the fact that 2,240 is an awkward figure to deal with, and that it is easier to use 2,000 lbs. in reducing large totals to tons. With an article so much used and so widely distributed as coal, there is every good reason for the speedy adoption of a uniform legal standard of weight in all the states. Our English tradition in this matter of weights and measures has led us into many absurdities; but the tendency of the present day is to simplify and reduce labor in all directions, and a decimal system of weights and measures, metric, or a modification of the metric, standard, must sooner or later be adopted. The short ton and the decimally divided foot used by engineers are steps in that direction already taken

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The rapid development of railway clubs in this country and the excellent work which they are doing is a matter to which we called especial attention a year ago.* Engineers in general do not realize the important factor which these clubs are becoming in the engineering and mechanical world, and especially do not fully appreciate the amount of valuable technical literature which they are accumulating in their proceedings. We are powerfully reminded of this fact in glancing over the last year's "Proceedings" of the Western Railway Club, whose closing meeting for the year we record in another column. Eight of these little pamphlets lie before us, covering the meetings from September, 1894, to April, 1895, inclusive, and still a ninth for the month of May is to come. Altogether about 350 pages are taken up with the papers, discussions and business proceedings of this club alone, and most of this printed matter, probably 90 per cent., is composed of papers read before the club, and then discussions by the members. Not only, moreover, is the quantity large, but the quality of the matter will stand comparison with that of any of the minor engineering societies, and not a few instances of papers well worthy of inclusion in the transactions of the national societies are found. In material prosperity the club shows up equally well. Its membership is about 620, there are no debts, it has a paid secretary, and it publishes its own proceedings. What has been said of the Western Railway Club is true, in a less degree, of the five other railway clubs which now exist in different sections of the country, although none of them has reached the standard of work done by the Western Railway Club. We have already discussed the influences which have brought about the growth of the railway club, and the good which it is destined to accomplish in the mechanical work of our railways if its efforts are properly directed, and we need not discuss these points further here. The railway club of the present day is doing work and making literature which no mechanical engineer can afford to let pass unstudied.

* Eng. News, May 15, 1894.

The planet Mars has for many years been the subject of a great deal of popular interest on account of the more or less general belief that it was inhabited. To state the case exactly, the astronomers conjectured years ago that certain changes in the appearance of the planet might be due to the increase and recession of a mantle of snow in the polar regions with the change of seasons. Manifestly if there was snow on the planet, there was doubtless also water, and inasmuch as water turns to vapor in a vacuum, the planet probably had an atmosphere of some sort. But, granting the existence of air and water, the existence of life was not impossible. Even human beings might, perhaps, inhabit the planet. These astronomical guesses were speedily clothed with a solid air of reality in the minds of the public, and for not a few years past a goodly number of persons have been anxious that we should show a proper neighborly spirit by communicating with the "Martians."

Several ambitious geniuses have proposed schemes for effecting such communication. It was once proposed to erect on some great plain, the Sahara Desert, for example, some mammoth geometrical figures, such as the geometrical demonstration of the Pons Asinorum. Then if upon Mars there actually existed snow, and water, and air, and life, and men, and if these men had reached a stage of civilization where they not only knew how to find the hypothenuse of a right triangle, but knew how to make and use telescopes as powerful as our own, why, then, and in that case, some Martian astronomer might some day discover a peculiar-shaped fly speck on the earth, and might study until he conjectured that the people of the earth were trying to signal to Mars—that is, if he didn't conjecture instead that the earth was inhabited by such giants that they used the tropical plains for a drawing board.

There really were a good many ifs with that scheme, and it never had much hold on the popular fancy. After electric lights came into vogue a much more taking idea was projected. It was suggested that if all the arc street lamps in London or Paris or New York were to be repeatedly lit and extinguished at short intervals, the "winking" would be visible to the Martian astronomers. By keeping up this persistently it was hoped to be able to attract their attention; and if they had electric lights there, they might wink back at us. Then, by the use of the Morse code, we might soon have a regular "cable" service between the two planets.

Popular interest in this subject was still further heightened by the discovery of the so-called "canals" in Mars, and ingenuity was turned toward guessing what the canals were and how they were made. This canal business was a little disconcerting to the plans of those who had been urging the signaling schemes. Evidently if Mars was inhabited by giants who built canals a hundred miles in width, they would hardly take the trouble to look at or speak to the pigmy inhabitants of the earth.

So we might continue, but there is no need, for,

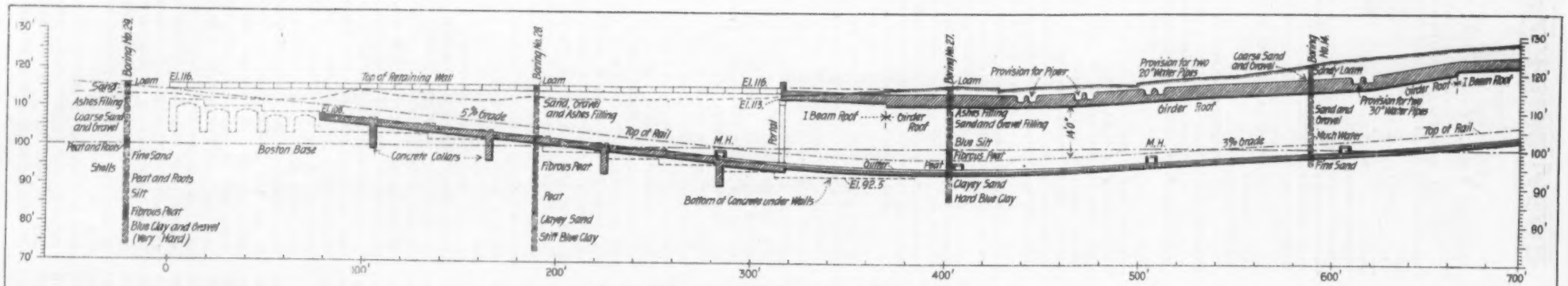


FIG. 2. PROFILE OF BOYLSTON ST. END OF SUBWAY.

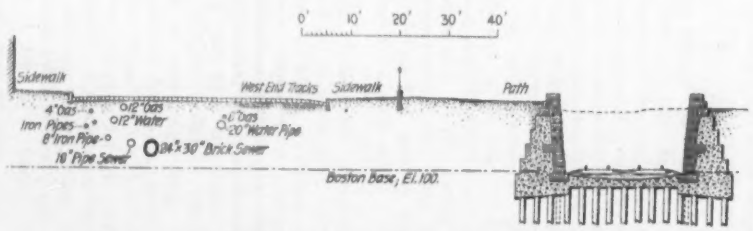


FIG. 3. CROSS-SECTION OF OPEN INCLINE APPROACH.

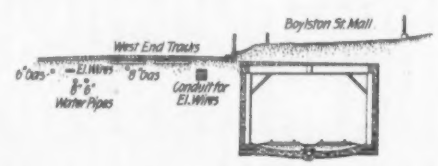


FIG. 4. CROSS-SECTION OF TWO-TRACK SECTION.

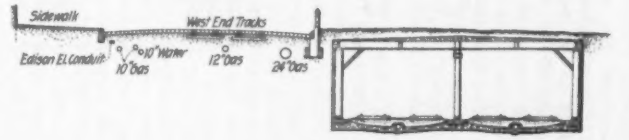


FIG. 5. CROSS-SECTION OF FOUR-TRACK SECTION.

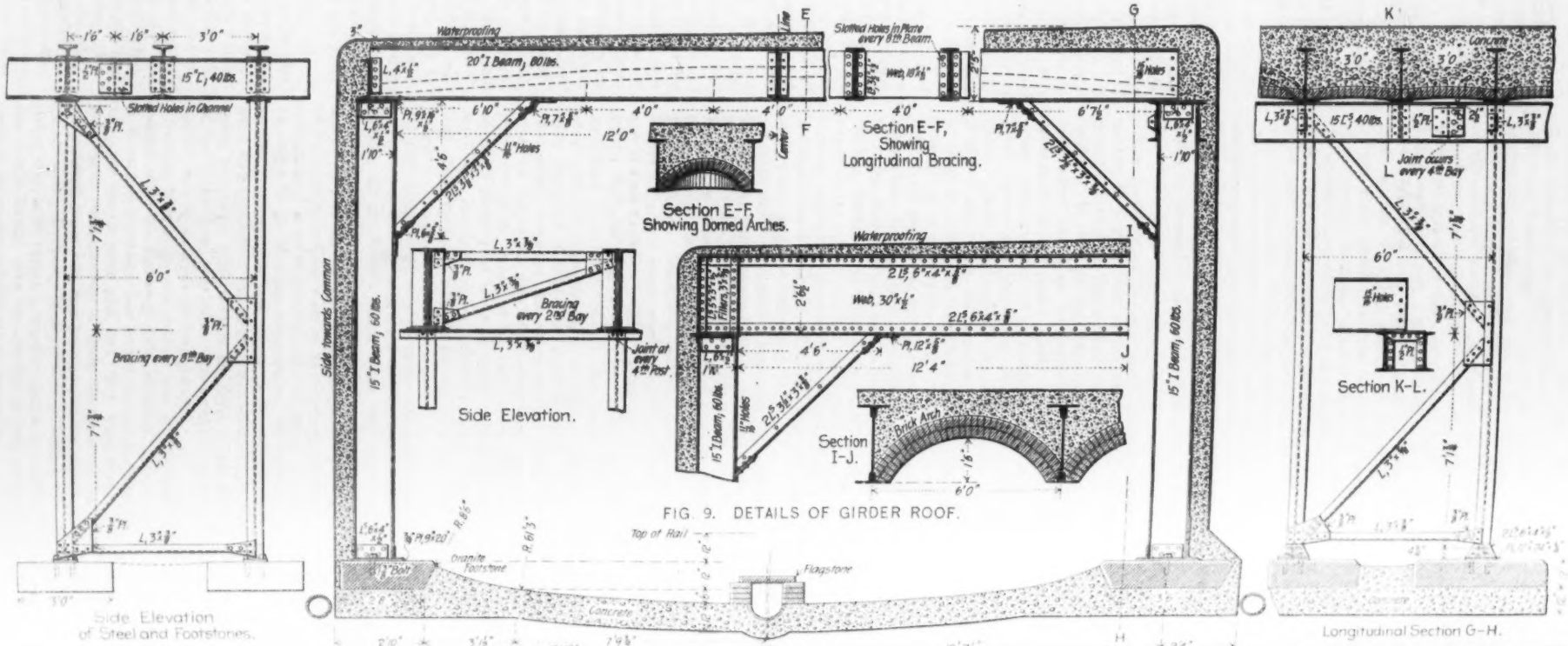


FIG. 9. DETAILS OF GIRDER ROOF.

FIG. 8. DETAILS OF TWO-TRACK SUBWAY WITH I-BEAM ROOF.

FIG. 8. DETAILS OF TWO-TRACK SUBWAY WITH I-BEAM ROOF.

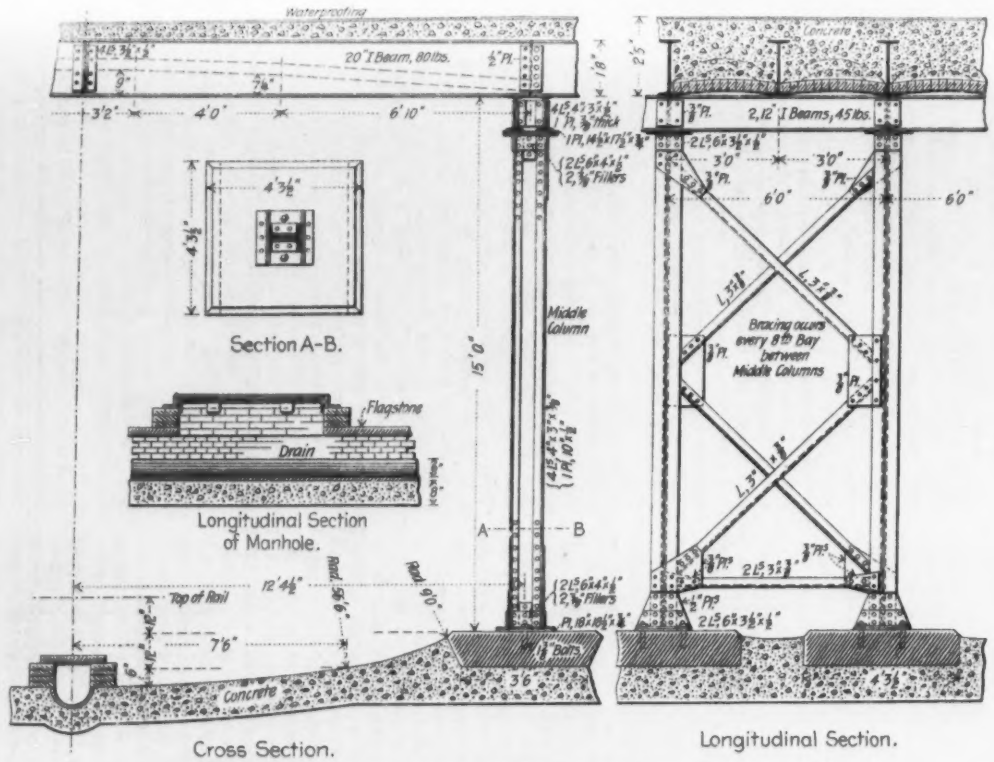


FIG. 10. DETAILS OF MIDDLE SUPPORTS OF FOUR-TRACK SUBWAY.

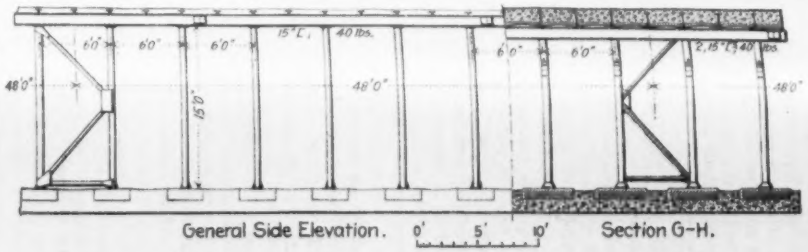


FIG. 7. GENERAL CONSTRUCTION, WITH CONCRETE OF SIDE WALL REMOVED.

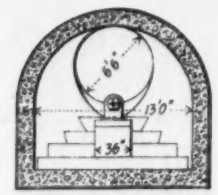
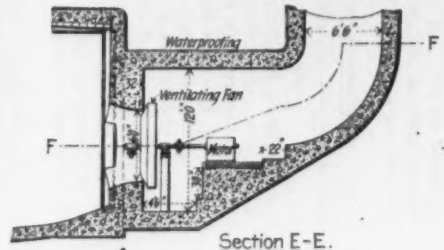
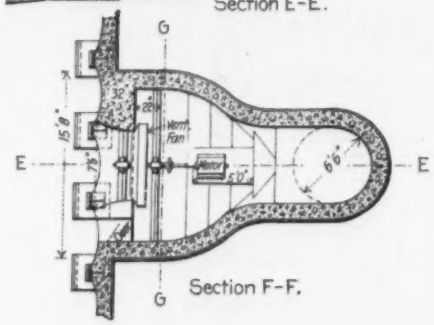
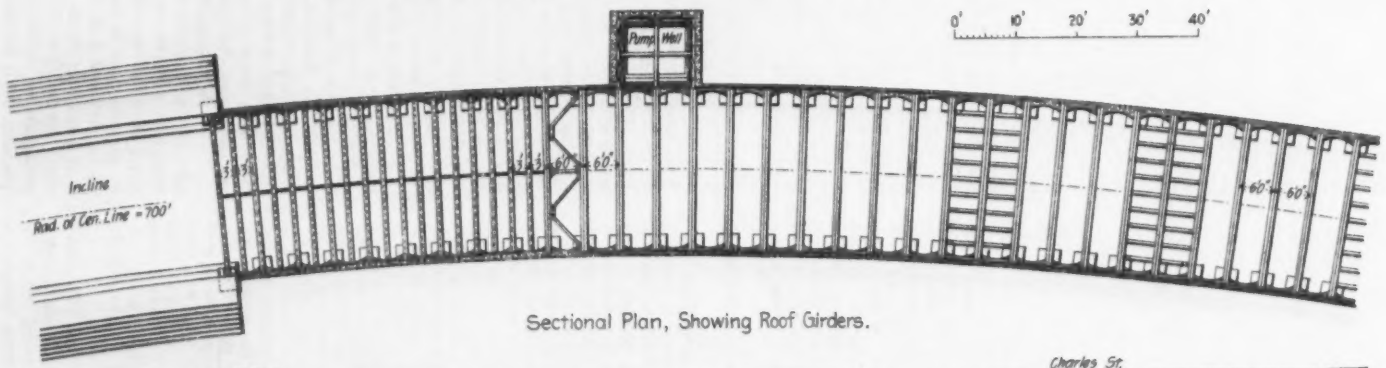


FIG. 11. VENTILATING CHAMBER.







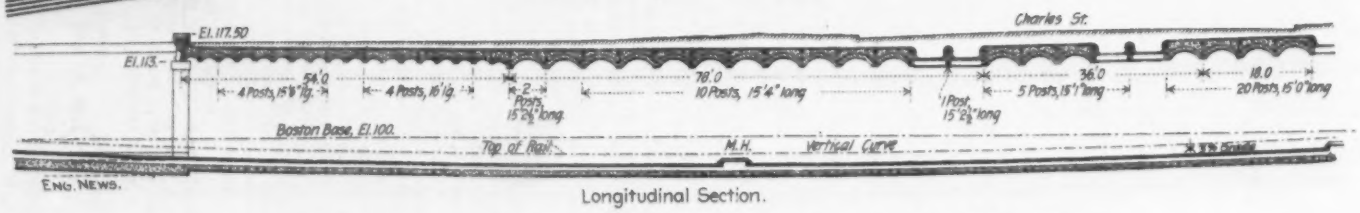


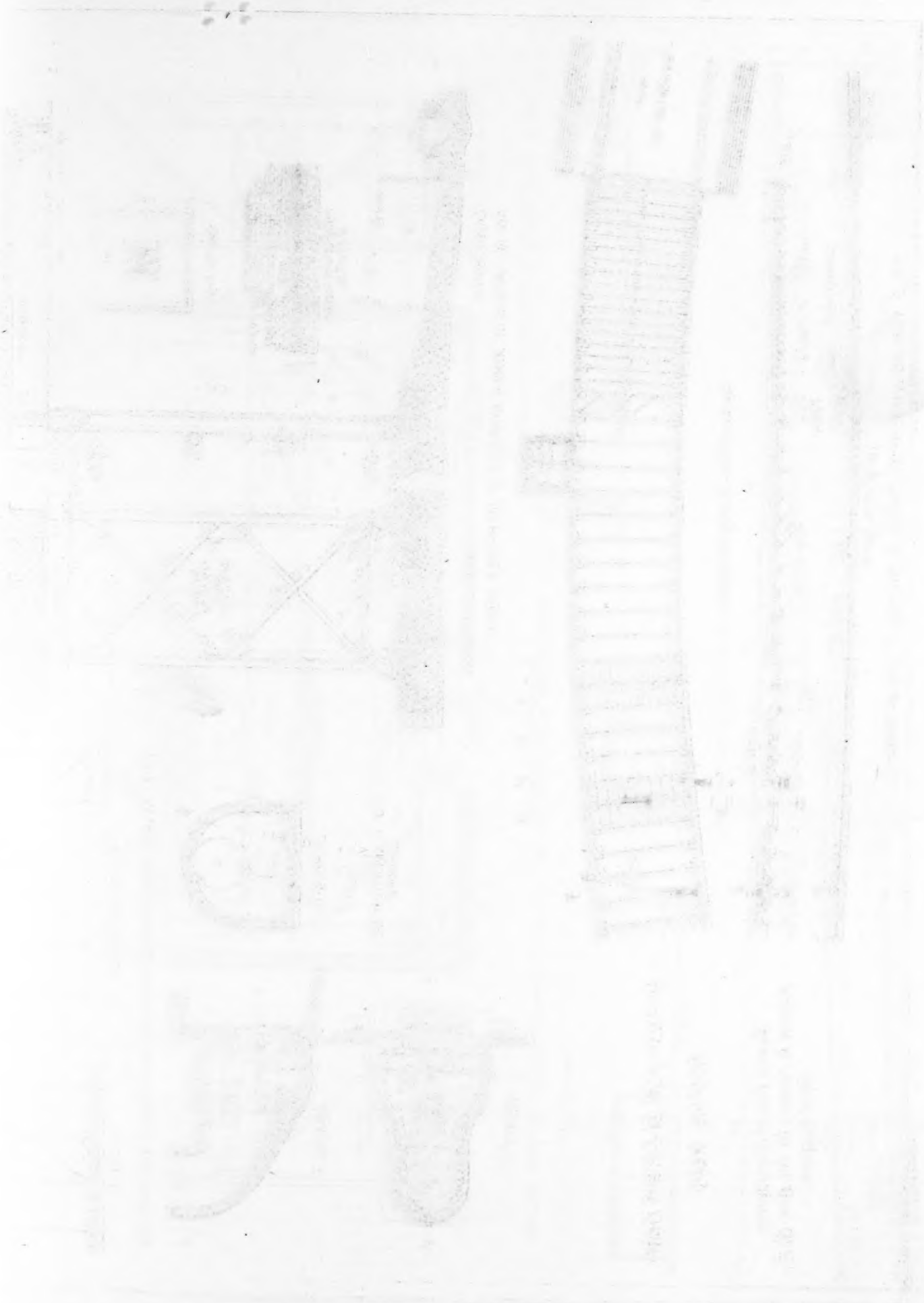
FIG. 6. PLAN AND LONGITUDINAL SECTION AT BOYLSTON ST. END OF SUBWAY.

SUBWAY FOR ELECTRIC CARS;

BOSTON, MASS.

Boston Transit Commission.
Howard A. Carson, M. Am. Soc. C. E.,
Chief Engineer.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.



if the spectroscope at the Lick observatory tells the truth, all these great schemes fall to the ground. The spectroscope says there is no air on Mars, or at least not enough to support life. No air means no snow, no water, no canals, no life, no inhabitants of any sort. It is just as well on the whole that we did not wink at Mars.

SHOULD THE BUILDING OF STAND-PIPES BE ABANDONED?

The valuable series of articles on stand-pipe failures by Professor Pence, which were recently concluded in this journal, and are about to be issued in book form, have, we find, aroused a great interest among engineers. Among the questions which are being seriously discussed are not only questions as to details of design, but it is even being suggested that the stand-pipe has on the whole proved so treacherous a device that engineers would do well in future to avoid its use so far as possible in designing new water-works systems or the extension of old systems.

It must be frankly acknowledged that there is some cause for this growing distrust of the stand-pipe. Professor Pence, in his most interesting monograph, has diagnosed the cause of the failure in each of the cases which he describes, and his explanation will, we believe, be generally accepted as well founded and extremely probable. And yet, allowing all he says to be true, it does seem strange that the infractions of the laws of good and safe construction in the case of stand-pipes should result in so many accidents. We entirely agree with the proposition that a better grade of steel should be put into stand-pipes, and that the specifications should be drawn to secure it. The idea that the steel is usually severely punished in stand-pipe erection in doubtless correct. Certain features in stand-pipe design which have proved weak should certainly be amended. And yet, after all, it is a little curious that the use of very ordinary metal, and brutal treatment in the shop and defects in design should altogether produce so much larger a percentage of failures in the case of stand-pipes than similar faults produce in other structures.

To make the case clearer, let us compare stand-pipes with steam boilers. As everybody knows, steam boilers are turned out in hundreds of shops all over the country, often with no sort of engineering supervision. They are made of metal that is sometimes good and sometimes (to state the case very mildly) not so good. They are punished in manufacture in about every conceivable way, and all sorts of liberties are continually taken with their design; and yet the "death rate" appears to be far higher in the case of stand-pipes than in the case of boilers.

Moreover, we have only given a small part of the comparison which goes to show that either steam boilers fail altogether too seldom, or stand-pipes fail altogether too often. In the first place, a stand-pipe is about the simplest possible construction in sheet metal, while a boiler is comparatively very complicated. The strains in a stand-pipe can be calculated to a nicety; the strains in many parts of a boiler, such as the stays, may vary within wide limits. Again, there is a multitude of things which may happen to a boiler to affect its safety. Its plates may be thinned by external or internal corrosion. Accumulation of scale or dirt on the heating surface may cause its burning or rupture. Grooving or pitting may cause local weakness. It may be subjected to over-pressure through defective safety valves or gages. Low water may leave the heating surface exposed. Contraction and expansion are continually causing internal strains which make many of the parts short lived. This by no means exhausts the list of evils which can befall a steam boiler; and yet, notwithstanding this, the boilers go on working, while stand-pipes, which have only two important dangers to contend against—wind and ice—have displayed a surprising disposition to "let go."

In view of these facts, it is of no small importance to consider the position which an engineer should take in this matter. Public confidence in the safety of stand-pipes has certainly been severely shaken. In not a few cases engineers will be called on to answer the question whether they are willing to assume the responsibility of placing stand-pipes in the vicinity of residences, and we apprehend that not a few members of the profession will refuse to approve such locations for stand-pipes.

Barring out failures due to known defects in design or material, Professor Pence's analysis has shown that failure of stand-pipes occur from three causes: (1) The internal pressure of the water; (2) the pressure of the wind; (3) strains due to the action of ice. So far as strains due to the hydrostatic pressure of the water are concerned, it may safely be said that the engineer can provide against them with absolute confidence. The amount of the strain can be calculated with the greatest accuracy, and the plates and riveted joints can be proportioned to take up this strain with the same confidence in their ability to do so that the bridge engineer feels when he proportions the eye-bars for a bottom chord.

But when we come to the field of wind action and ice action it may as well be confessed that no such certainty is possible. The latest writers on wind action are agreed that the intensity of pressure over very small areas may reach figures higher than have hitherto been allowed. A stand-pipe exposes but a small area, and any pressure near its top exerts a large leverage to increase the pressure upon the leeward side of the foundation, and set up vertical strains in the tube itself. Our knowledge of the action of ice is even less positive than our knowledge of wind action. Only enough is known to show that ice in a pipe is an excellent thing to avoid, for many reasons.

If, then, an engineer would build a stand-pipe on whose safety under any and all weathers he will dare to stake his reputation, he should strive to eliminate, so far as possible, the elements of wind strain and ice action, and this he may do by substituting an elevated tank for the stand-pipe. Not a few of such elevated tanks have already been built, and, so far as we know, they are giving as good satisfaction as stand-pipes of equal capacity.

In first cost, comparative estimates have generally shown, we believe, little difference between the two types of structure, such advantage as exists being frequently on the side of the elevated tank. The latter has also the advantage of storing the water at a higher level, and keeping up the pressure longer, when heavy demands in case of a fire exceed the capacity of the pumps and the water in the reservoir is finally all drawn out. The water in the lower part of a stand-pipe is usually at too low a level to be of use for fire purposes. Again, the elevated tank lends itself more readily to aesthetic treatment. A stand-pipe is never a thing of beauty, and attempts to adorn it generally result in making a bad matter worse.

In the present discussion, however, we are chiefly concerned with the relative safety of the two types of structure. So far as internal pressure of the water is concerned, the two stand on the same footing. The higher pressure in the stand-pipe is offset by the larger diameter of the elevated tank. But, as we have said before, it is within the power of a competent engineer to design either tank or stand-pipe so as to be practically entirely safe, so far as internal pressure of the water is concerned.

Turning now to the strains produced by the wind, it is well understood that in stand-pipes such strains can only be determined approximately. In an elevated tank, on the other hand, the tank itself is of so large diameter in proportion to its height that it is a very stable structure. The strains in the columns of the tower which supports it can be computed with the same accuracy as those in the columns of a railway viaduct or the top chord of a bridge. The batter given the tower enables it to resist wind pressure with less strain on material and foundation than is the case with the vertical walls of a stand-pipe. Finally, in cases where aesthetic considerations do not prohibit leaving the tower itself uncovered, the wind strains on the lower part of structure are so much reduced as to become insignificant.

The other great enemy to stand-pipe stability—the formation of ice in cold weather—may be dismissed in a few words. It is clear that a stand-pipe, being a tall, slender cylinder, exposes a large surface in proportion to its volume, and its protection, so as to prevent ice formation in severe climates, is a matter of extreme difficulty. The tank, on the other hand, exposes a much smaller surface in proportion to its volume, and it is a matter of little difficulty or expense to carry a light wooden covering all around its sides, and cover the whole with a roof. Such a covering, with, in extreme climates, a little of the heat which is ordinarily wasted up the chimney or in the exhaust steam at the pumping station, would entirely prevent the formation of ice, and would have the added advantage of diminishing the danger from frozen mains in winter, and of keeping the stored supply cooler and purer in summer.

Stand-pipes are perhaps a little simpler structures to design; contractors are more accustomed to their erection, and in certain localities the matter of first cost may be slightly in their favor. If there are any other reasons for preferring the stand-pipe to the tank, we have yet to hear of them; and it seems entirely probable that a much larger proportion of elevated tanks will be built in the future than has been the case in the past.

On the other hand, it has not been the purpose in the above discussion to bring any serious indictment against the stand-pipe on the score of danger. With the better design and construction, which we believe Professor Pence's labors have done much to bring about, there is no reason why a stand-pipe should not be a reasonably safe structure. As we have said with respect to other matters, safety is a relative, not an absolute term; and it is merely to point out the reasons why a well-designed elevated tank may stand higher in the scale of safety than an equally well-designed stand-pipe that this article is written.

LETTERS TO THE EDITOR.

LENGTH OF HALF-MILE TROTTING TRACKS.

Sir: Mr. C. H. Schumann contributed a brief letter in your issue of May 9 concerning the dimensions and cross-slopes for a half-mile trotting course. He has given the radius of the semi-circular curves as 226.2 ft., and the length of straight sides, 900 ft., as the dimensions of a regulation track. The writer is not sure that Mr. S. is not right, but he has thus far supposed a track of regulation or standard dimensions should be of 660 ft. straight sides, with curves of the same length, measured or computed on a line 3 ft. outside the inner edge or "pole" of the track. Will Mr. S. or some one else give the authority for the regulation dimensions he has given, if the same are correct? In the course of my professional practice I have laid out four half-mile tracks, two of them of the dimensions above stated, tangents and curves being of equal length. On straight sides the cross-slope given was 1 in 40, and on both curves 4 in 40, modifying between the two different slopes within 75 ft. either way from the tangent points.

E. P. Augur.

Middletown, Conn., May 14, 1895.

COMPUTING COMPARATIVE ECONOMY OF CEMENTS.

Sir: In your issue of May 16 Capt. W. L. Marshall suggests a method of ascertaining the comparative economy of various cements. The difficulty in applying such a method lies in the fact that it assumes the actual value of the material to be shown by tensile tests of mortar a few days old.

It rarely happens in such a series of tests that the mortar which is the strongest at seven days is also the strongest after three months, while the cement which gives the mortar of highest strength when a year old is usually to be found among those of average or low strength on early tests.

The attempt to grade different brands of cement by their behavior under the ordinary tensile test is, therefore, to attach undue importance to that test, and to give it duties quite outside of its legitimate purpose. The object of this test should be to determine whether the mortar sets and hardens properly, and the requirements should be only such as will secure this object for the grade of material to be employed.

There is a certain danger also in placing a premium on high early strength, due to the fact that the attainment of such strength is sometimes at the expense of the soundness of the cement.

Predictions as to the future of a sample of mortar, from a tensile test extending over a short period of time, can only be based upon full knowledge of the usual action of the particular brand of cement under examination.

Very respectfully, Fred P. Spalding.

Ithaca, N. Y., May 18, 1895.

FALL OF A BRIDGE ON AN ELECTRIC RAILWAY.

Sir: About 2 p. m. on Saturday, May 18, an electric car of the Schuylkill Valley Traction Co. fell through a highway bridge over the Trenton cut-off of the

Pennsylvania R. R., near Norristown, Pa., and I visited the scene on May 19 and gathered the following facts:

The bridge was about 60 ft. span, and consisted of two wooden Howe trusses 10 ft. 6 ins. high, with panels 10 ft. 6 ins. long. The upper chord was made up of three pieces 5 × 10 ins. Lower chord, three pieces 5 × 12 ins. Floor hangers, 8 × 14 ins. Plank flooring. It was a through bridge, on a skew of about 20°. The street car track was on the east side, leaving the rest of the roadway clear for wagon traffic. The height of floor above top of rail was about 23 ft.

The car was a new one, this being its first trip, and was said to weigh 12 tons. It was going south, and left the track while on the bridge and ran for some distance, when it struck the end post of the east truss, knocking it out and causing the truss to fall outwards. The west truss stood for a moment and the car came down sideways, front end first, and dragged the west truss with it. Scratches on the face of the abutments show the direction in which the ends of the trusses slid in falling. There were 13 persons in the car, but no lives were lost. I enclose a clipping from the Sunday "Press." Harrison Souder, C. E.

Philadelphia, Pa., May 22, 1895.

The Philadelphia "Press" states that the bridge was a temporary wooden structure, 72 ft. long and 30 ft. high, and it appears to have been known to have been unsafe. Traction engines have been a frequent cause of the failure of old wooden highway bridges, and heavy electric cars running at speed on suburban and country lines seem likely to increase the number of such accidents. The clipping enclosed is in part as follows:

When the Norristown & Conshohocken Passenger Ry. Co., now merged into the Schuylkill Valley Traction Co., attempted to lay its tracks on the bridge last summer the Pennsylvania R. R. Co. sought by injunction to restrain the laying of the tracks after the electric railway had already laid its roadbed on the bridge, alleging that the bridge was a temporary structure and was inadequate to accommodate the increased strain. The electric railway company filed exceptions, and the matter is now pending in the courts. The defendant company also produced testimony as to the adequacy of the bridge to accommodate its cars, and the successful result of a practical test was shown to the Court, a car containing 110 persons having crossed the structure last August. Anticipating what the Court might possibly decree in the event of so much doubt, the trolley people erected a wooden pillar to give additional support to the center of the bridge. Last October these supports were removed by the Pennsylvania R. R., because, as it alleged, no permission was given for their construction, and that they occupied the company's property by trespass and interfered with the uses of the railway. To establish the responsibility for the accident will be an interesting legal problem that the courts will probably be called upon to decide.

SLOPE LININGS FOR RESERVOIRS.

Sir: I was very much interested in an article appearing in your issue of March 14, on a double lining for reservoirs, and according to the invitation extended in your last paragraph, send a few facts that have come under my personal observation, with photographs illustrating the conditions mentioned. From the effects observed on the different reservoirs shown, it appears that a simple concrete lining to the top of the bank is more expensive and less efficient than a compound lining.

The effect of frost on an exposed reservoir bank, covered with a layer of clay puddle and then 6 ins. of concrete is shown by Fig. 1. The cracks have just been filled with cement and show very plainly on the left hand side, while the same line of cracks runs completely around the reservoir. The reservoir was built in 1885, and has been a source of expense to the water company ever since the cracks developed the first winter. The action of the frost forces the concrete out from the top, and as warm weather comes it lets it drop back, showing an ugly crack in the face. The line is strongly marked about 3 ft. perpendicularly from the top of the bank. The cracks are not at the water level, as the flow line of the reservoir is within 1 ft. of the top.

Fig. 1. View of Reservoir Showing Cracks in Concrete Slope Lining.

A small reservoir lined with concrete and having a layer of broken stone above the berm on which was laid stone pitching, was built in 1887, and the company owning it has not spent more than $50 from that day to this in repairing it. It is perfectly tight, the stone paving is somewhat out of line from ice and the concrete below the berm is slightly scaled, otherwise it is all right.

Another reservoir of which I know is lined with two layers of brick, one flat, the other on edge, laid on the material, a fair quality of clay, taken out of the excavation. The brick lining is carried 1 ft. above the water line, and the remaining 3 ft. are sodded. It was laid in 1890, and as yet has had no repairs made on it.

A reservoir completed in 1893 and now in perfect condition has a concrete lining with stone pitching on broken stone and sand above the berm. This reservoir is alongside of the one with cracks, Fig. 1, and subject to the same conditions.

Fig. 2 shows a lining of stone pitching on sand, being put on the slopes of the Brooklyn storage reservoir near Baldwin's station, L. I.

Fig. 3 shows a similar lining on the dam of the Pottsville Water Co. at Kauffman's, Pa. At the time of the break in 1891, the water was drawn off rapidly, and the lining slid to the bottom.*

Yours respectfully, L. A. Francisco, C. E.

Easton, Pa., March 16, 1895.

Fig. 2. Laying the Stone Paving on Sand for the Brooklyn Storage Reservoir, Near Baldwin's Station, L. I.

Fig. 3. Slip of Stone Paving on Kauffman's Reservoir, Water Supply of Pottsville, Pa.

SPECIFICATIONS FOR THE SCHENECTADY STAND-PIPE.

Sir: We enclose a copy of the specifications recently prepared by us for a steel stand-pipe in connection with the new water supply for the city of Schenectady, N. Y. You will notice that the specifications for material are taken bodily, with few changes, from the specifications for steel stand-pipes by Professor Pence, published in Engineering News of Feb. 28, 1895, which seemed to us so good in both matter and wording as to make any material change in either undesirable. We enclose a list of the bids received on May 9. We take this means of acknowledging our indebtedness to your paper. Yours truly,

The Stanwix Engineering Co.

Rome, N. Y., May 18, 1895.

(The stand-pipe called for was 32 × 100 ft., on foundations to be furnished by the city. The steel is to be soft open hearth, with not over 0.08% phosphorus for acid or 0.06 for basic steel. The thickness of the plates, from the bottom upwards, and the details of rivets and joints, are shown in the accompanying table.

It is interesting to note that the specifications require that the stand-pipe shall be painted with "two coats of black varnish approved by the engineer and of a quality equal to Edward Smith & Co.'s 'Black Bridge Paint.'" This "paint" we understand to be a modification of Prof. A. H. Sabin's Japan coating for water pipes and other metal, described in our issue of Feb. 7, 1895. The latter requires that the metal to which it is applied must be baked, but this "paint," which is really a varnish, is so prepared as to make baking unnecessary.

Three formal bids for the stand-pipe were received on May 9, 1895, under the above specifications, as follows: Ranton Boiler Co., Syracuse, N. Y., $8,335, to whom the contract was awarded; Riter & Conley, Pittsburg, Pa., $9,638; Enterprise Boiler Co., Youngstown, O., $10,994. The Elmira Machine Co. bid $9,100, but did not enclose the required check, and Tippett & Wood, Phillipsburg, N. J., offered to build a wrought iron stand-pipe for $9,045. —Ed.)

* Views of all six of the reservoirs mentioned above were sent by Mr. Francisco. The three presented were selected as being the most instructive.

Thicknesses of Plates and Details of Joints and Riveting in the New Stand-Pipe for Schenectady, N. Y.

Course.	Rivets. Thickness plate, ins.	Rivets. Diameter, ins.	Rivets. Pitch, c. to c., ins.	Rivets. Dist. between pitch lines, ins.	Kind of vertical joint.	Thickness cover plates, ins.
1..	7/8	1	3 1/4	2 5/8	D'ble-riv'd butt	1/2
2, 3..	13-16	1	3 1/8	2 5/8	" "	7-16
4..	3/4	1	3	2 1/2	" "	7-16
5..	11-16	7/8	2 7/8	2 3/8	" "	3/8
6, 7..	5/8	7/8	2 5/8	2 3/8	" "	3/8
8..	9-16	7/8	2 5/8	2 3/8	" "	5-16
9, 10..	1/2	7/8	2 5/8	2 3/8	" "	5-16
11..	7-16	3/4	2 1/2	2	" "	1/4
12..	3/8	3/4	2 1/2	2	" "	1/4
13..	5/8	3/4	2 1/4	1 3/4	D'ble-riv'd lap	..
14, 15..	5-16	5/8	1 7/8	1 5/8	" "	..
16..	1/4	5/8	1 7/8	1 5/8	" "	..
17, 18..	3-16	1/2	1 3/4	1 1/4	" "	..
19, 20..	3-16	1/2	1 1/2	...	S'gle-riv'd	..

Horizontal courses are to be placed alternately inside and outside, with single-riveted lap joints, these rivets to correspond in size with those given in the table for the same thickness of plate, the pitch to be three diameters of the rivets. All butt joints shall have inside and outside covering straps. The distance from the edge of any piece to the edge of the rivet holes shall not be less than 1½ diameters of rivet.

AN APPEAL TO ENGINEERING NEWS.

Canajoharie N. Y. 3/23 1895

Engineering News, and

R. L. Calkins Esq.

C. C. C. New York, City.

Sir,

Some american's things. At first blush pray excuse all my mistake and the my bad expression.

Now I take the pleasure let you know something good. I claim to you because I do knowing where they living and how they call the Superintendent, Chief Engineer, Road Master or te President R. R.s

You know that the West Shore R. R. on March 2 get some men to work on the Railway's extension. Who men all living in Canajoharie. The Foreman is named Bob. Everyone so call him. All they are Italian and the men's number is 15. From everybody who got the job, he, the foreman—take $5.00.

If you like know the truth about this business you can interrogate—under swearing—Cony Mastriani, an old laborman on R. R., who give him anticipate $20.00 for the following men: Joseph Litto, James Maturo, Cony Agriesti and Gerald Giardino, on the afternoon in his home at Rock Str, on the same day March 21.

On the same day's morning I went to him.

"Bob, have you job for me?" I tell.

"No, have not job all," he said.

Well, on the afternoon when he have received the money, you should believe that?—he give to me the job.

And be all, wish a little justice for so many poor men, and call in my help the public press, who not only are undressed by Americans, but also from the Italians. Respectfully, P. P.,

Canajoharie, N. Y.

Engineering News, and

to West Shore R. R. Co.,

New York, City.

(Our cast iron rule to take no notice of anonymous communications had to be relaxed in the above case, as the writer's sincerity was as marked as were his struggles with the English language, and we forwarded the letter to Mr. C. W. Bradley, General Superintendent of the West Shore R. R., who replied that he would at once have the complaint investigated. That he did so with satisfactory re-

results we conclude from a perusal of a second letter received from the writer of the above, which we reprint below verbatim. We should add that a full name was signed to this second letter, but we withhold it from publication, lest "Bob" should take vengeance in approved Sicilian fashion for the loss of his ill-gotten five-dollar bills.—Ed.)

Engineering News & American Ry. Journal
communicate for
R. L. Calkins C. C. C.
Grand Central Station
New York City.

Sir,

First thing I take the pleasure let you know that I have received the Bank's cheque $5.00 worth for my lost groceries on January last and thank you very much.

Returning again for the last time on subject of my last letter, like me add something also. On the Sunday evening March 24 Frank Second gave to same Boss Bob living at same place in Canajoharie N. Y. for Tony Warner $2.00 saying thus: he poor man, he no have no one cent more: next pay day he set everything.

If you will know and obtain something, you can call every one who are been named before the Company's judge. It is reasonable. Interrogate somebody separately, all deny. Who are working, they like not lost the job. Who expect the job—they like not lost the money. And be all.

Besides I am glad to have manifested at Company this dirk business, and complete a duty not only toward the my conscience, but also towards to society— Respectfully

Very truly yours

Fonda N. Y. 15/4 1895 * * *

COMPUTING STRESS IN LATERAL BRACING.

Sir: On page 490 of "Theory and Practice of Modern Framed Structures," 2d ed., appears a footnote by Prof. Johnson, referring to the specification requiring that: "An addition of 10,000 lbs. must be made to the stress obtained in all lateral rods, to provide for initial tension." The footnote is as follows:

Whenever the working stress in these members exceeds twice the initial stress, the initial stress in the counter-rod has disappeared, and hence does not need to be added.—J. B. J.

This statement, as it stands, is undoubtedly a safe one. But in case of material as rigid as wrought iron or steel, does not the initial stress practically disappear whenever it is exceeded by the working stress? Will Prof. Johnson be kind enough to give, through the columns of Engineering News, an explanation of the theory, or process of reasoning, by which the above conclusion is arrived at? Benj. F. La Rue.

Scranton, Pa., May 8, 1895.

(We referred the above letter to Prof. Johnson, and append his reply as follows:—Ed.)

Sir: Referring to the letter of Mr. La Rue, I take pleasure in responding as follows: On page 228 of "Modern Framed Structures" the following footnote was added in the third edition:

In the case of initial stress in counters in any panel, the shear in this panel from external loads divides itself between the diagonals by increasing the stress in one and diminishing it in the other. Thus, if a_1 and a_2 are the areas of cross-section of the two counters, and S is the shear from external forces, the portion of this shear taken by a_1 is $\frac{a_1}{a_1 + a_2} S$, and the portion taken by a_2 is $\frac{a_2}{a_1 + a_2} S$, being additive in the one case and subtractive in the other, so long as both remain under stress.

The above states the general fact as to the distribution of the shearing force in a panel containing counters. In accordance with the above statement of facts, if the two counters are of the same size, as they always are in a lateral truss system, then so long as both of these counters are under stress, one-half of the shear is carried by each, by adding to the stress in one and reducing the stress in the other. Thus, suppose the initial stress in each of these counters was such as to be equivalent to 10,000 lbs. lateral component (that is to say, if the diagonals should have an angle of 45° with the axis of the bridge, the stress on each rod would be 14,100 lbs.). If, now, an external shear be applied to this panel of 10,000 lbs., one-half of it would be carried by one of the diagonals in a way to increase its stress by 7,050 lbs., and the other would have its stress reduced by 7,050 lbs., leaving in this latter one-half its initial tension. We see, therefore, that it would require an external shearing force in this panel of 20,000 lbs. in order to reduce the stress in one of the diagonals to zero, and up to this limit the external shear has been equally divided between the two diagonals, in accordance with the principles enunciated in Proposition III., p. 220 of "Modern Framed Structures," namely:

When there are two or more paths over which a load may travel to reach the support, the load divides itself among the several paths strictly in proportion to the rigidities of the paths.

That is to say, there being two diagonal members in this panel, both in tension, it is possible to have each of them carry a shearing stress of either sign, so long as the compressive stress which is placed upon one of them does not exceed the initial tension already in it. In other words, either one of these tension diagonals may be regarded as a rigid compression member for a load equal to the initial tension which has been given to it; and since the cross-section of these two diagonals are equal, they are equally rigid and distort equally under equal loads.

I think a little consideration given to this problem would enable any one to see that when there are two diagonals in any panel, both under stress, an external shearing force must divide itself between the two, in accordance with the law of their relative rigidities, and that these relative rigidities will be directly as the relative cross-sections of the diagonals themselves. If this be so, the stress does not vanish from one of these until an external shearing force equal to twice the shearing component of the initial stress in one has come upon the panel. Furthermore, that after the initial stress has vanished from one of these diagonals, the other one can be carrying only the stress due to external forces. That is to say, after the external shearing force on the panel has come to be equal to twice the initial shearing component of the stress in the diagonals, this initial stress is no longer to be added to the stress from the external forces. This particular proportion applies only to the case of diagonals of equal cross-section. In the case of a panel not central in the main truss of a bridge, where the diagonals are of different sizes, the effect of the initial stress in the smaller diagonal would be to add to the stress in the large diagonal until the stress in the smaller one had been reduced to zero, in accordance with the law stated in the quotation made above from page 228, after which its effect on the main diagonal has vanished.

The reader, instead of utilizing Proposition III., quoted above, might reach the same conclusion by regarding the rectangle of the panel as being distorted by the external shearing force, in such a way as to lengthen one diagonal and to shorten the other by an equal amount, thus increasing the stress in one and reducing the stress in the other, both of which actions result in the taking up of external shear and in the proportion of the relative areas of the diagonals.

J. B. Johnson.

Washington University, St. Louis, May 18, 1895.

COMPARATIVE MERITS OF IRON OXIDE AND LEAD PAINTS FOR METAL STRUCTURES.

Sir: In Mr. Emil Gerber's interesting paper, entitled "Painting of Iron Structures Exposed to Weather," read before the American Society of Civil Engineers May 1, 1895, and abstracted in your issue of April 18, is much that is suggestive. All the data gathered, however, may not be all the data that can be collected with reference to the structures examined. Moreover, the interpretation made may not be that which other engineers would make.

In the paper occurs mention of a number of instances of rust being found under the paint and reference to this as not active or dangerous, especially speaking thus of yellow rust. According to the best chemical authorities, yellow iron rust always indicates the presence of water, the most energetic element of corrosion. Where the author found considerable rust beneath the paint, especially if this paint was oxide of iron, he explains its presence as having not been removed from the iron before being painted. The lack of adequate proof on this point invalidates his conclusions. How is he sure that this rust was not caused by the applied coat of iron rust with oil?

We do not ask this question with reference to the lead painted structures examined, as he says (p. 40): "Lead paints are undoubtedly neutral, as is shown by the numerous white lead mill marks which were scraped, and under all of which the metal was found perfectly clean." Moreover, these bridges having been erected by the management for whom the author made the examination, is it not a confession of neglect if this rust was left on the iron originally and was not caused by the presence of the iron oxide paint by absorption of moisture and oxygen in the manner commonly accepted?

The inference that the author considers softness in paint a point of excellence can hardly be avoided. For instance (p. 5): "The condition of the paint was excellent, and in most places still soft." He frequently mentions finding iron oxide paint in this condition, though never lead paints. A paint that is soft cannot be thoroughly dry, and a paint that is not entirely dry cannot be waterproof. Mr. Gerber would hardly put his boat in the water while the paint was soft and not completely dry. Certainly the author would not recommend the use of paints on iron which would not absolutely exclude moisture; but in advocating oxide of iron paints on account of their softness after a protracted period, this line of reasoning would inevitably lead to such conclusion. Painters always introduce japan, made by combining manganese, litharge or red lead with linseed oil, into paints whose pigments are inert with the vehicle, manufacturers of oxide of iron pigments, among others, insisting on the necessity of this to insure drying. Red lead, however, alone of all paint solids, combining chemically with the linseed, does not require an oil-destroying drier, thus affording a paint which dries hard and elastic and is impervious.

The author says (p. 42): "The lead compounds are always artificial combinations, while iron oxides can be obtained in abundance from nature without any preparation, except grinding." Unfortunately for this statement red lead, which is here evidently meant, is not an artificial combination, but essentially a natural product, being merely pure lead plus oxygen. It is reduced from the pure metal lead, consequently is necessarily uniform and free from impurities. All iron oxides as found in nature just as certainly contain foreign matter, no two samples of iron ore ever analyzing exactly the same. That this matter is undesirable is freely admitted in effect by the author when (p. 8), in speaking of bad rust blisters, he says: "These blisters are, no doubt, caused by earth falling off cars and lying on these chords for a long time." But in this paint he has earth present all the time.

Moreover, iron oxide paints are almost invariably adulterated. Prof. A. H. Sabin, speaking on this, says: "Some of these paints are sold at prices which preclude the possibility of using linseed oil." The well-known firm of bridge inspectors and chemists, Hunt & Clapp, of Pittsburg and Philadelphia, in writing to a firm in the latter city, after saying commercial samples of oxidizers' brands of red lead are practically always pure, give as representative of iron oxide paints the following analysis:

Clay and silica	19.90
Alumina	8.18
Oxide of iron	26.72
Carbonate of lime	30.19
Sulphate of lime	14.05
Magnesia	.52
Water and organic matter	.44
	100.00%

Chas. L. Condit, in his "Painting and Painters' Materials," hits off this class of pigments thus: "There is a more efficient agent for producing rust than even carbonic acid, to wit, rust itself. All rust (not having been roasted) contains water, especially yellow rust." Yet Mr. Gerber advises us to mix water with oil and bring water in contact with iron.

M. P. Wood, in his able paper, "Rustless Coatings for Iron and Steel," read before the Am. Soc. M. E. (Eng. News, July 19, 1894, and Jan. 31, 1895), lays down as a condition essential to good work that the members should be: "Free from any percentage of mixture with iron oxide, a substance decomposed by moisture," which he further characterizes "as sensitive to and as soluble in water as mill pond mud." Under this classification comes the paint used by Geo. S. Morison (p. 2) by whose instructions Mr. Gerber made the investigations which are the subject of his paper. But to further quote this careful authority:

"The principal paint chemists, who buy and use paints instead of selling them, unite in condemning any oxide color that contains over 50% of sesquioxide." Referring then to the analysis of the paint used in the majority of bridges inspected, Mr. Morison's favorite, the "Cleveland Iron Clad," we see from its 93% of sesquioxide it would come under the ban of those who have made the preservation of iron surfaces a life study.

In this connection, an explanation by Mr. Gerber of the results presented below, which are rather at variance with his conclusions, would be in order: Mr. C. I. Brown, M. Am. Soc. C. E., Chief Engineer of the St. Louis & San Francisco R. R., under date of Aug. 20, 1892, writes:

I have just gotten some good testimony from our bridge master, Mr. G. W. Turner, of Springfield, Mo. He sent me a sample of iron from one of our old bridges which was painted with red lead in 1870. The bridge stood until 1889, when it was taken down and the pieces thrown in the scrap pile. The paint is still in good condition, and there is absolutely no rust or scaling of the iron. He also sent me several samples of pieces from the scrap pile which had been painted with the iron-clad paint which we are now using. These pieces are all entirely devoid of paint and eaten badly with rust, in spite of the fact that they were painted in 1887.

As to iron oxide paints in general, Prof. A. H. Sabin, the well-known chemist, in a paper before the New England Railroad Club recently (Eng. News, Feb. 7, 1895), says concerning them:

These paints are fairly durable, and some of them

very durable, on wood; but on iron they have not proved to be so, and experience has shown that the metallic oxide acts as a carrier of oxygen to the underlying iron, causing it to rust instead of protecting it. For this reason these paints have been unsatisfactory and, to a large extent, abandoned. . . . You all know that good iron paint on a car will last about as long as the car will, and that the iron roof painted with the same paint will not last more than three years. . . . As you go over the country you see that bridges are not painted with oxide of iron any more.

That the author is not without prejudice and is, therefore, hardly to be relied on either as a witness or a judge, take his treatment of the Union passenger station, St. Louis. Here his own inspection compels him to say (p. 27), "the general appearance was good." But this personal examination being favorable to red lead, he was not willing to acept it; but, on the basis of the engineer's representations that the red lead and lampblack were damaged at the base of the columns, though only where subjected to the unfavorable conditions of being brought in contact with the alkali of the concrete, etc., he asserts in his summing up (p. 42): "The trainshed of the St. Louis Union station, painted with red lead throughout, is already scaling." In this conclusion, on another page from the original mention, he does not repeat that red lead and lampblack were used, but says merely, "painted with red lead throughout." Almost in the next paragraph, but in another connection (p. 42), he remarks: "The lasting qualities of paint colored with lampblack are well known." In admitting which accepted fact, so in accord with his own examination, he stultifies himself in endeavoring to let the impression go forth that red lead on this work is a failure.

Not only do Mr. Gerber's remarks lead to the suspicion that he had a predilection for iron oxide before he made his examination, but they give the impression in a number of instances that he may not be an expert in such examinations, and that, in fact, he even doubts his own ability and methods. Take for example (p. 4) when he says: "The condition of metal under paint here was not examined as carefully as on subsequent bridges for lack of experience as to what to look for." This uncertainty and distrust of himself comes to the front again when, in inspecting work erected by other than his employer, Geo. S. Morison, he admits his inability to decide the character of the pigment, not being able to recognize even oxide of iron, much less red lead, when, as on the Polk St. viaduct (p. 34), he says: "Apparently oxide of iron," "presumably white lead." This, however, does not make him hesitate to give a dogmatic verdict against red lead.

Does Mr. Gerber recognize that no one is so well qualified to pronounce on the success of a suit of clothes as the man who lives in them day after day. Possibly Mr. Gerber did not have even the superintendence of the construction of any of these bridges. At any rate, none of them were built for his service or for that of his employer. A resident engineer is the best qualified to pass on the wear of a bridge under his charge and what paint protects it best. A man must be in the habit of working in his garden to know why some plants succeed and others do not. Mr. Gerber would hardly care to assume the position that the large majority of chief engineers of the leading railways in the U. S. did not recognize the importance of adequately protecting their metal surfaces, or did not sufficiently examine and keep track of the wear of paint and the metal underneath it to be reasonably sure in their own experience what kind of paint was best.

In the face of this careful superintendence by resident engineers, which must be conceded, possibly Mr. Gerber would explain why iron oxide paint, the covering power of which "has not been questioned, as far as the writer knows" (p. 39), but in proof of which, "mill and shop marks (lead) were frequently visible through paint" (iron oxide) (p. 24), should have been so generally discarded when, according to Prof. A. H. Sabin, "There was a time when nearly all the iron bridges in this country were covered with these paints" (iron oxide). There should also be a reason why the management of considerably over half of the railway mileage of this continent, embracing the most important construction extant, should have decided on red lead as their standard protective for ironwork. The same reason will account for the adoption by the United States and the other leading countries for their navies and by the merchant marine of the world of red lead. It is because, after examining, testing, comparing, using scientifically and practically in a manner so thorough that compared with which Mr. Gerber's investigations are as the "first reader" to Sanskrit, everything offered, all kinds of iron oxide paint included, they have found red lead the best thing for the least money.

Ralph K. Wing.

1 Broadway, New York city, May 15, 1895.

(We submitted a proof of the above letter to Mr. Gerber before publication, and append his reply as follows:—Ed.)

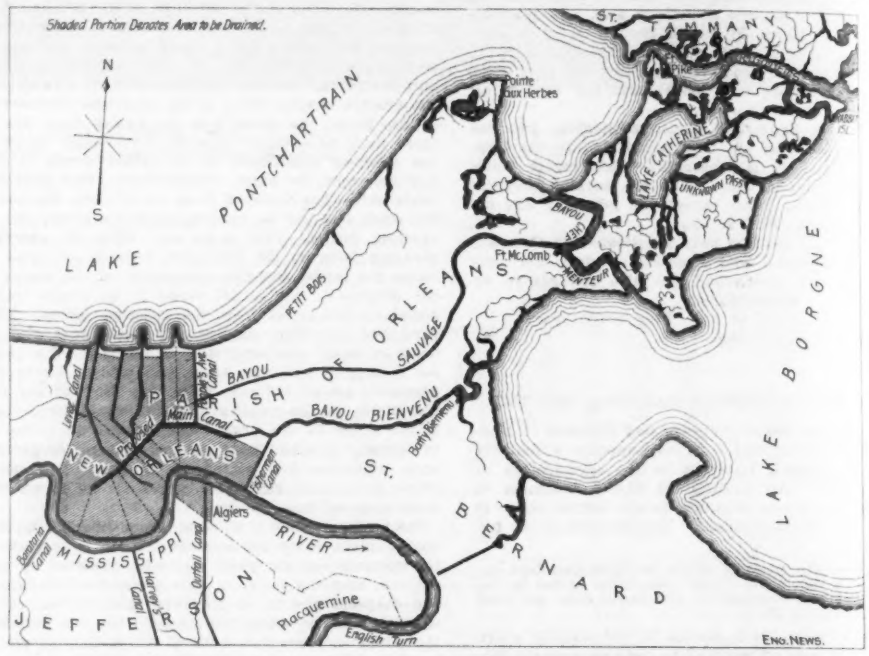
Sir: Mr. Wing has evidently criticised my paper from the standpoint of a dealer in red lead. His arguments and conclusions are not borne out by a careful reading of my paper, and the most important part of the paper he hardly notices. It is not so much a question of quality of paint as condition of metal before paint is applied, and this he tacitly admits by speaking about negligence. Yours truly,

E. Gerber, M. Am. Soc. C. E.

The Temple, Chicago, Ill., May 25, 1895.

THE DRAINAGE OF THE CITY OF NEW ORLEANS, LA.

This journal has from time to time given notes, cross-sections and current news of progress of the proposed drainage of the city of New Orleans; but the lately-issued report of the Advisory Board, dated April 29, 1895, furnishes the material for a



MAP OF VICINITY OF NEW ORLEANS, SHOWING PROPOSED DRAINAGE SYSTEM.

better understanding of the unusual natural difficulties to be overcome and the methods proposed towards this end. The engineer members of this board are Messrs. B. M. Harrod and Henry B. Richardson, both of New Orleans, and Mr. Rudolph Hering, of New York, acting in conjunction with Mr. L. W. Brown, City Engineer.

This committee of six members, including the Councilmen upon it, was appointed on Dec. 14, 1893, to investigate and submit a complete and comprehensive plan for the drainage of the city, a previous ordinance of Feb. 6, 1893, having provided for the making of a topographical survey of the city.

The drainage of a city, parts of which lie nearly 20 ft. below the flood level of the Mississippi River, presented unusual engineering features, and the system to be adopted had to consider the inevitable growth and development of the city and the increasing demands of modern ideas of sanitation, comfort and economy. The old so-called drainage of the city was in a deplorable condition; it having been deemed sufficient in the past to adopt makeshifts intended to meet immediate demands and benefiting small and disconnected areas. The result was a crude system of drains and canals, insufficient in size, uneconomical pumping methods and a final disposal which is becoming more and more objectionable. The recent establishment of a sewerage system, separate and distinct from the proposed drainage system, materially affects the plans for the latter by removing from consideration the disposal of household waste. The present drainage question, therefore, applies principally to the removal of the rainwater falling upon the built-up sections of the city, which do not penetrate the ground and cannot, owing to the topography, drain into the river. It applies also to the removal of a portion of the ground water which at present saturates the soil and creates unsanitary conditions, or makes property in certain sections useless.

The plans adopted are intended to thoroughly drain and keep dry all the territory now built upon, or that is likely to be built upon within a reasonable time. This area is indicated upon the maps given herewith. The requirements of a drainage system of the above character first demanded what did not then exist—a complete topographical survey of the territory in question, indicating in the fullest detail present and proposed streets, elevations, character of the soil as to permeability, built-up and paved areas, etc. This survey has now been made, and in general terms it may be said that the territory to be drained is highest along the Mississippi River, where the elevations average about 33 ft. above the Cairo datum. The ground slopes from the river bank towards Lake Pontchartrain for about 9,000 ft. from the river, down to an elevation of about 20 C. D., or about the low-water level of the Mississippi River. From the foot of this slope to the lake the surface is practically flat, with the exception of the slight rise of the Metaire and Gentilly ridges, which practically are parallel with the lake shore, and 2¼ miles from it. Between these ridges and the lake the average elevation is 22 C. D., and the ground is swampy and waste land. Between the ridges mentioned and the foot of the slope a large portion is below mean Gulf level. The two canals leading from the lake to the city are used for commercial purposes, and are leveed to prevent the water of the lake from inundating the low portions of the city.

Another essential factor in planning the new system was an intelligent knowledge of the quantity of rainwater falling upon the area to be drained during the heavy storms occurring several times a year. The old rainfall records stated only the total amount of rainfall in 24 hours at points within the city limits. To obtain the necessary data for a continuous record, six self-registering rain-gages were established at selected points on April 1, 1894, and since that time they have supplied valuable data as to the varying intensity of storms, their duration, etc.

A third essential factor was the amount and rate of the greatest "run-off" or the volume of water flowing from the surface and entering the drains and canals during heavy rainfalls. Reliable information on this head was wanting, and the Board obtained it as accurately as possible in the short time available, by actually gaging the water discharged daily at the several drainage machines, and comparing the amounts with the known rainfall. Owing to the many controlling factors, further and more elaborate investigation will be required to accurately decide upon definite figures of run-off.

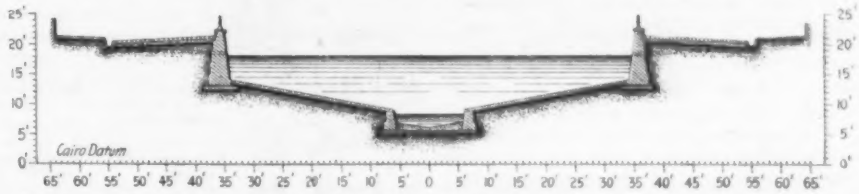
The project proposed by the Board is as follows:

First the water will be discharged into Lake Borgne. Lake Pontchartrain was first considered, as it is nearer the city, and the canals would have been shorter and less expensive. But numerous pleasure resorts are located along its shores, and it was deemed advisable to protect it even from slight pollution, especially as this lake is land-locked and there is no material circulation in its waters. The shores of Lake Borgne, on the other hand, are wholly uninhabited; it is open to the Gulf with a more rapid rise and fall of tide; its mean level is a few inches lower than that of Lake Pontchartrain; it is the natural outfall for the drainage of a large part of the city, and, by dredging the Bayou Bienvenu, can be utilized as an outlet nearly to the levees of the city. While Lake Borgne is recommended as the main outlet, it is also stated that in heavy storms the amount of water to be discharged is so great that it is impracticable to carry all of it to Lake Borgne; and as the water at such times is least objectionable, relief canals are therefore recommended at suitable points to convey this excess to Lake Pontchartrain.

The total territory is divided into five main drainage systems, with the Algiers territory, on the right bank of the river, treated as a separate system. The areas of these sections vary from 2,153 to 8,887 acres. The main canal, located as shown on the map, has a width of 70 ft. at the water surface, and a depth of 15 ft. below the mean natural level (20 C. D.); the estimated discharging capacity is 3,000 cu. ft. per second. It is proposed to line the bed and sides of this canal with a smooth and permanent material, with a view to insuring cleanliness and a good velocity and discharge. Navigation canals will probably be crossed by large iron pipes, carried under or over them.

From the main canal will start branch canals, with constantly decreasing capacity, separating into main drains, branch drains and surface gutters, extending to the limits of the system.

The length of the main canal would be seven miles, and the ground alongside is practically level, ranging from 19.5 to 21.5 C. D. This canal will answer two distinct purposes—it will first remove the ordinary drainage flow to the proposed outfall. But, owing to the great distance and absence of fall, such ordinary flow must be given a suitable velocity, and this will be accomplished by locating five main pumping stations along the canal, which, by lifting the water at these points, will give it an artificial slope. Secondly, the main canal is to carry away the water to such an extent that the first wash of the surface will go to Bayou Bienvenu and Lake Borgne. The capacity of the main canal has been designed with this point in view. When the capacity of the lower end of the canal becomes insufficient to carry off the storm water, the pumps will deliver the excess into the branch relief canals leading to auxiliary pumping stations, and thence into Lake Pontchartrain. The estimated total dry-weather flow from the five drainage sections is 38 cu. ft. per second.



TRANSVERSE SECTION OF PROPOSED MAIN CANAL, NEW ORLEANS DRAINAGE.

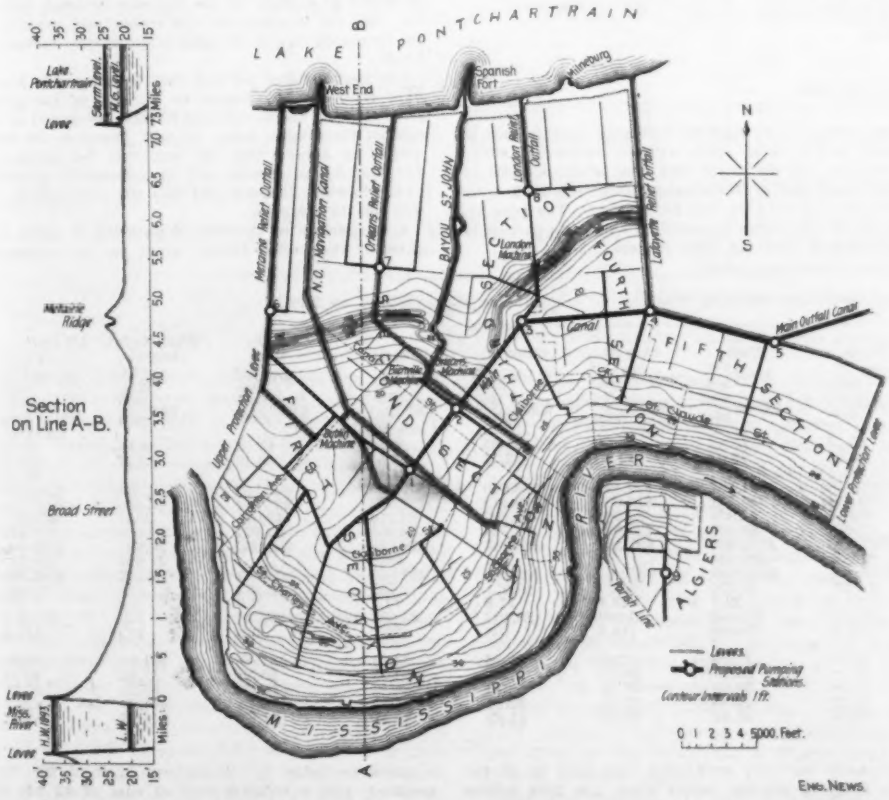
After suggesting the proper order in which the work should be prosecuted, the Board furnishes estimates of cost—first, for the whole area to be drained and for the ultimate and entire completion of the work; and secondly, in accordance with the recommendations as to first work to be performed. These estimates are as follows:

Approximate Cost of Whole Drainage System.

Canals and drains, lined	$3,499,203
" " " unlined	909,707
Main canal, lined	1,224,000
" " unlined	263,781
Outfall canals, unlined	112,000
Pumping stations, main	1,003,750
" " auxiliary	831,250
Total	$7,933,691

Approximate Cost of First Work.

1st section, pumping stations Nos. 2 and 7	$300,000
2d section, branch canals and drains	850,000
3d section, relief branch canal, etc.	128,000
4th section, relief branch canal, etc.	23,000
Total	$1,301,310



CONTOUR MAP OF NEW ORLEANS, SHOWING PROPOSED DRAINAGE DISTRICTS AND CANALS.

In an appendix to the report some further details and definitions are given as follows: The Cairo Datum, often referred to, is a plane 21.26 ft. below mean Gulf level, and it is the datum to which all New Orleans elevations are referred. In the present system there are five draining machines, shown in location upon the contour map presented. These would be replaced by nine pumping stations in the proposed system, including the Algiers section, on the west bank of the Mississippi River. During the past 40 years various attempts have been made to secure a proper system of drainage for the city; but, with the exception of some work done in 1871-73, nothing of any permanent value, or of the nature of a comprehensive system has been executed.

The existing system of drainage consists of open canals, receiving the water from the small street gutters in the higher portions of the city, and then, by the machines mentioned, lifting this water about 5 ft. and delivering it into Lake Pontchartrain. These machines drain, imperfectly, about 13,357 acres, have been in use for 40 years, with one exception, and are consequently primitive and wasteful of power.

The report includes tables of rainfall, run-off gagings, etc. But the Board has comparatively recently instituted these gagings, and states that further data are necessary to establish conclusive results upon which to base detailed plans of canal sections and capacity.

THE ATLANTA CONVENTION OF THE AMERICAN WATER-WORKS ASSOCIATION.

The fifteenth annual convention of this Association was held in Atlanta this week. Several of the papers read at the convention are printed in this issue, and the following is a telegraphic report of the first day's proceedings from the member of our staff in attendance at the convention:

The proceedings of the convention were opened by an address of welcome by Mayor King, of Atlanta, and Hon. George Hillyer, President of the Atlanta Water Board. Judge Hillyer said that Atlanta was among the pioneer cities in the use of meters and filtration. The two improvements, he considered, should go together, for it was folly to go to great expense to filter water and fail to make the best measures to restrict its waste. The efficiency of the Atlanta fire department has been greatly increased by the use of meters. The records of the Department showed that in 2,000 alarms there was only once when fire pressure was not obtained immediately on attaching the hose.

Following this came the address of the President of the Association, Wm. Ryle, of Paterson, N.J. He suggested that the purification of water by electrical means would be an excellent subject for discussion at the next annual meeting. The Executive Committee in its report advised the payment of $800 to the Secretary for his services during the past year. It was voted that advertisements be inserted in the annual reports at the same rates as last year.

The reading of papers was then begun, and the paper of Mr. Artingstall on the cost of pumping, which is printed on another page of this issue, was read. Mr. Lineen desired to discuss the paper, but was unable to do so, as no printed copies of the tables accompanying the paper were at hand for reference, thus emphasizing the defect in the handling of papers before the Association, which we pointed out in our last issue. The morning session then adjourned.

A large number of members are in attendance, and the hospitality extended by the people of Atlanta promises to make the meeting a very enjoyable one. The exhibit of water-works appliances is smaller than usual; doubtless owing to the long distance from the manufacturing centers; but the principal dealers in supplies are well represented.

COST OF PUMPING WATER FOR CITIES, TOWNS AND VILLAGES.*

By Samuel G. Artingstall, M. Am. Soc. C. E., City Engineer, Chicago, Ill.

The expense of operation and maintenance of pumping plants for supplying potable water for cities, towns or villages varies very much in different localities, and even in different stations in the same locality. The accompanying Table II. shows the cost of pumping water at the different stations of the Chicago water-works. All the cost given in the tables is expended in and around the pumping stations, and does not include any charge for bringing water to or delivering water from the pumps to the city. Through the courtesy of the engineers in charge I have also obtained similar information from six large cities, which is presented in Table II. and compared with that for Chicago.

The pumping stations named in Tables I. and II. include all the water supply pumping stations in the city of Chicago, excepting Norwood Park, where the pumpage is very small and intermittent. With the exception of Washington Heights, the pumps at all the stations included in the table take their water from wet wells fed by tunnels extending out under Lake Michigan, to intake cribs located two and four miles from shore. Washington Heights station is supplied by an artesian well, from which the water is pumped by a deep well pump discharging into a basin from which the supply pumps take their water.

TABLE I.—Description of Pumping Stations; Chicago Water-Works.

Station.	Type of engine.	Built.	Pumps.	Capacity in 24 hours, gals., 1 = 1,000,000.	Type of boiler.	Type furnace.
North	1 vert. beam condensing	1853	Single acting.	7.5	4 internal fire box with flues and tubes.	Flat grate
"	1 " " "	1857	Single acting.	13.0		
"	1 " " "	1867	Double acting.	18.0		
"	1 " " "	1872	" "	36.0	8 return flue tubular.	Murphy automatic.
"	2 Gaskill hor. comp. condensing.	1887	Direct double acting.	24.0		
Total capacity, North pumping station				98.5		
West	2 vert. beam comp. condensing with Corliss valves.	1876	Single acting.	30.0	6 return flue tubular.	Flat grate.**
"	2 vert. beam comp. condensing with Corliss valves.	1884	Single acting.	30.0	6 return flue tubular.	Hawley d. drft.
Total capacity, West pumping station				60.0		
14th St.	3 vert. triple expansion, built by E. P. Allis Co.	1891 1892	Single acting out.pack. pls.	45.0	9 return flue tubular.	Hawley d. drft.
Central	3 vert. triple expansion, built by E. P. Allis Co.	1889	Single acting out.pack. pls.	30.0	6 return flue tubular.	Murphy automatic.
68th St.	1 Gaskill hor. comp. condensing.	1886	Direct double acting.	12.0	18 return flue, 6 out of service.	Fitted fuel oil burners.
" "	1 " " " "	1888	Direct double acting.	12.0		
" "	2 " " " "	1892	Direct double acting.	24.0		
" "	1 Worthington hor. comp. cond..	1890	Direct double acting.	12.0		
" "	*2 Cope & Maxwell	1882	Direct double acting.	6.0		
" "	*1 Knowles	1878		3.0	2 locomotive, out of service.	
" "	*2 Holly vert. comp. condensing.	1881		8.0		
Total capacity, 68th St. station				77.0		
Lake View	*1 Flanders HP. condensing	1875	Double acting.	2.5	7 return flue tubular.	Hawley d. drft.
" "	1 Worthington hor. comp. cond.	1884	Direct double acting.	5.0		
" "	1 Gaskill hor. comp. condensing.	1888	Direct double acting.	12.0		
" "	1 " " " "	1892	Direct double acting.	12.0		
Total capacity, Lake View station				31.5		
Washington Heights.	1 deep well pump, pumping from artesian well to surface basin.		Direct double	0.5	2 return flue tubular.	Flat grate.
"	1 Smith-Valle h.-p.		Direct double acting.	1.0		
"	1 Smith-Valle h.-p.					
Total capacity, Washington Heights station				1.5		

* In occasional service. ** Since changed to Hawley down draft.

The pumps at all stations discharge directly into the mains, and in most cases without connection with a stand-pipe. At the north and west stations there are stand-pipes, and at Washington Heights a tank which serves as a stand-pipe and for storage. The pipe system of the city forms a connected whole, no portion being detached from the main system.

The unit of work performed is taken in the table as the raising of 1,000,000 ft.-lbs. of water 1 ft. high, and the total cost per unit is based on the total expense of operation and maintenance. The unit cost of coal for fuel during 1894 is excessive on account of the anthracite coal used, as mentioned above. There were also unusual repairs made at several pumping stations during 1894, and the total cost per unit is somewhat higher than usual. The cost of fuel given in the table includes fuel used for pumping, changing boilers, heating station, and, in some cases, running electric light engine.

The north pumping station, which pumps the largest quantity of water, gives the lowest unit cost, omitting fuel, but owing partly to the non-economical and old machinery, and partly to the use of anthracite coal, the total unit cost is higher than at any other station, excepting Lake View and Washington Heights. At the 14th St. and central stations the dry wells in which the pump cylinders are located extend about 17 ft. below lake level, and include the whole basement area below the engine-room, with the exception of the space taken up by foundations. There is a small amount of seepage water entering these sub-basements which is pumped out by small pumps, which discharge into the sewers. The coal used in these stations includes that used in operating these drainage pumps and in heating the stations.

Fuel oil is used at the 68th St. station. The unit cost is lower at this station than at any other in the city. This is partly due to the use of fuel oil and partly to the fact that the head pumped against is higher than at other stations. The machinery which is usually in operation at 68th St. is of a modern type and in good order. It is economical in fuel and needs little in the way of repairs.

As all the water furnished at Washington Heights has to be raised by two separate pumps, and they not economical in the use of steam, the cost is extremely high. The salaries per unit are high because of the small annual pumpage; in fact, if we compare the different stations of the city, the cost per unit for salaries appears to bear some relation to the amount of the annual pumpage, as it is the highest at the station pumping the least water during the year, and, with two exceptions, where the difference is small, it decreases as the annual pumpage increases. An increase in head tends to slightly increase the cost of salaries, oil and stores, and repairs. The increase in total cost of these items will, however, be very small, and as the number of gallons raised 1 ft. (supposing the amount of pumpage to be constant) is increased in direct proportion to the increase in head, the cost per unit for salaries, oil and stores, and repairs will be decreased nearly in proportion to the increase in head.

The cost for fuel per unit will be somewhat less for high than for low heads, on account of the greater proportion of useful work performed per pound of coal against the greater head. It will, therefore, be nearly correct to assume that the unit cost for salaries, oil and stores, and repairs will be reduced in proportion to the increase in head, and that the unit cost for fuel will remain the same.

A comparison of the cost of pumping in seven large cities of the United States, based on this assumption is given in Table II. A uniform head of 200 ft. is assumed, and a uniform cost of coal of $2 per ton. For the results to afford a correct comparison the quality of coal used would have to be the same at all the plants. When a high grade of coal has been used, as at Boston and Milwaukee, for instance, the result in unit price is comparatively too low; and at stations where the low grade of coal is used, the price is correspondingly too high. The data for this table is taken mainly from the annual reports of the cities named.

TABLE II.—Cost of Operating Pumping Stations on the Chicago Water-Works, in 1894.

	Station. North.	West.	14th St.	Central.	68th St.	Lake View.	Washington Heights.	All stations combined.
Anthracite coal, tons	13,351 65/2000	1,928 1550/2000	1,180 1258/2000	1,162 165/2000	.....	507 1250/2000	39 1250/2000	18,169 1838/2000
Bituminous " "	8,802 1997/2000	13,995 1003/2000	8,269 746/2000	6,265 145/2000	283 800/2000	6,973 1925/2000	558 1900/2000	45,149 516/2000
Fuel oil, gallons	.....	.....	.....	.....	1,909,968	.....	.....	1,909,968
Anthracite coal, price per ton	$5.57	$5.35	$5.35	$5.35	.....	$5.75	$5.84	$5.52
Bituminous " " " "	$3.08	$2.97	$2.80	$2.78	$3.51	$3.42	$3.47	$3.01
Fuel oil, price per 100 gallons	.....	.....	.....	.....	$1.49	.....	.....	$1.49
Total cost of fuel	$101,438	$51,887	$29,492	$23,650	$29,415	$26,752	$2,171	$264,807
Salaries	$49,819	$40,331	$43,906	$29,182	$37,560	$23,914	$3,230	$227,946
Oil, stores and lighting	$4,304	$3,839	$2,968	$2,662	$6,216	$3,021	$151	$23,161
Repairs to buildings, pumps, engines and boilers	$1,853	$9,807	$20,916	$7,768	$3,053	$5,374	$1,068	$49,841
Total expense of operation and maintenance	$157,416	$105,865	$97,284	$63,263	$76,246	$59,063	$6,621	$565,760
All other expenses combined	$1,065	$16,824	.....	.....	$807	.....	$1,521	$20,219
Grand total of expenses	$158,481	$122,690	$97,284	$63,263	$77,053	$59,063	$8,142	$585,979
Total gallons pumped during the year (1 = 1,000,000)	21,699	19,276	16,052	10,257	12,788	6,853	132	87,060
Per cent. of pumpage of city as a whole	24.9	22.1	18.4	11.8	14.7	7.9	0.2	100
Average pumped per day, gallons (1 = 1,000)	59,449	52,838	43,990	28,104	35,037	18,776	362	238,521
Average head against pumps, ft.	110.8	104.86	113.1	103	127.7	113	112	111.6
Cost of pumping 1,000,000 gals. 100 ft. high:								
For salaries	$2.07	$1.99	$2.42	$2.76	$2.30	$3.09	$21.78	$2.34
" oil, stores and lighting	$0.18	$0.19	$0.16	$0.25	$0.38	$0.39	$1.02	$0.24
" repairs	$0.08	$0.48	$1.15	$0.73	$0.19	$0.69	$7.20	$0.51
" fuel	$4.22	$2.56	$1.02	$2.24	$1.80	$3.45	$14.63	$2.72
Total	$6.55	$5.23	$5.36	$5.99	$4.67	$7.63	$44.63	$5.82

Ordinarily the only anthracite coal used is at the north pumping station, where there are four boilers not suited to burning soft coal without producing an objectionable amount of smoke; but during the strike period of 1894 bituminous coal was not always available, and considerable anthracite was used at all stations. The bituminous coal used is largely from the Indiana and Pennsylvania fields, giving an evaporation of 8½ to 9 lbs. from and at 212°. Hocking Valley and Youghiogheny are occasionally used.

* Abstract of a paper read before the Atlanta meeting of the American Water-Works Association, May 28-30, 1895.

THE RISE AND PROGRESS OF RIVER AND HARBOR IMPROVEMENT IN THE U. S.

At a late meeting of the Franklin Institute, in Philadelphia, an interesting lecture was delivered upon the above subject by Mr. L. Y. Schermerhorn, C. E., for a long time U. S. Assistant Engineer on river and harbor work. An abstract of this lecture follows:

The present national policy of the conservation and improvement by the general government of the navigable waters of the United States has been the outgrowth of a century's action and legislation. Chief Justice Marshall first decided that the power of Congress is complete, absolute and exclusive over all the navigable waters of the United States, and that this power may be exercised with no limitations beyond those prescribed by the Constitution. While, at first, the term navigable waters was confined to the Great Lakes and the more important waters in which the tide ebbed and flowed, at the present time the Acts of Congress and the decisions of the United States Supreme Court apply this term to the Great Lakes, their direct tributaries, the connecting links between these lakes and all other waters, whether tidal or not, upon which, directly or indirectly, the government has entered for the purpose of improvement, and which have a navigable capacity sufficient to float rafts, skiffs or saw logs. Under these broad premises and conclusions the government exercises its present control over the work of improving rivers and harbors.

But to return to earlier history; the fundamental English theory, adopted in her colonies, was that rivers and bays existed only for the purposes of commerce, and when the American colonies revolted and became separate states, each state maintained that it had independent control over the navigable waters within its borders. Under the "Articles of Confederation," in force from 1777 to 1789, Congress had no power over commerce or navigation, and each state enacted such laws in this connection as seemed best to its authorities. Dire confusion and rivalry resulted and commerce was disorganized to such an extent that individual state action was voted a failure, and in the Constitution of 1789 it was enacted that "Congress alone should have power to regulate commerce among the several states." The power thus broadly conferred has been repeatedly interpreted by the Supreme Court to extend to all the navigable waters of the United States whereon commerce is carried.

Little was done by Congress in the improvement of our navigable waters until the beginning of the present century. The first regular appropriation for this purpose made by Congress was in 1802, when it was enacted that $30,000 should be spent in erecting public piers at Philadelphia, then the most populous of American cities, with 81,000 inhabitants. Since that date the government has expended $7,000,000 in the harbor, river and bay near that city. The public revenue of the country was small at first, and there was little to devote to the improvement of navigation; but the importance of the development of navigable waters was early impressed upon Congress, and in 1819 that body provided that 5% of the proceeds derived from the sale of lands in the territory of Alabama should be reserved and applied to making public roads and canals, and improving the river navigation in that territory

In 1822 an important work was commenced in Delaware Bay by appropriating $22,700 for the beginning of two piers to form a harbor of refuge. This was the beginning of the Delaware Breakwater, the first work of its kind in the United States, and upon which the general government has now expended $2,728,000. In 1824 the President was authorized to have surveys made of such roads, canals and rivers as he might deem of national importance, and report the results to Congress. This work was completed in 1825, and, as one result, the Secretary of the Treasury was authorized to subscribe, in the name of and for the United States, to 1,500 shares of the capital stock of the Chesapeake & Delaware Canal and to vote these shares in the election of officers. In 1826 similar subscriptions were authorized for the stock of the Louisville & Portland and the Dismal Swamp canals.

The first approach to a river and harbor bill was made in 1826, in the administration of John Quincy Adams. This first bill aggregated about $150,000 and was applicable to about 20 localities. From 1826 to 1838 Congress made annual appropriations for this purpose and expended about $9,000,000 in this interval. After 1838 there was a change in public policy extending to 1866. In this period of about 28 years only three regular river and harbor bills were passed; in 1844, 1852 and 1864. Small appropriations were made in other years; but they were for the repair and maintenance of work previously commenced. In this period, 1838-1866, the aggregate expenditure on this account was $6,600,000.

After the close of the Civil War and the return to peace and industrial activity, the pressing need was felt of the fuller development of our waterways, and a beginning was made in a new policy which has since steadily expanded. Excepting one year only, 1877, annual appropriations for river and harbor work were made from 1866 to 1882. From 1882 to 1894 the appropriations were biennial and they were passed during the even years of each Congress. By the River and Harbor Act of 1890 the Secretary of War was authorized to enter into contracts for the entire completion of certain named important improvements, under previously determined plans and estimates of cost; these contracts to be carried on from time to time as Congress makes appropriations for them. There are about 18 works of this class now in progress, and the appropriations for them are withdrawn from the regular river and harbor account and are contained in the Sundry Civil Act, annually passed by Congress to incur liabilities for work previously authorized. The total appropriations under this head, since 1890, aggregate $26,331,343.

Mr. Schermerhorn gives a list of annual appropriations for river and harbor work, covering each year from 1820 to 1894, along with the number of works. The first sum was $9,500 for two works; the appropriation of 1838 reached $1,535,500, and then it dropped suddenly to $1,100 in 1840. In 1844, the appropriation was $722,600, and in 1852 it was $2,141,300, with comparatively small amounts in intervening and following years until 1866, when $3,881,100 was set aside for this work by Congress. The annual amounts rapidly swelled until, in 1894, the sum of $20,643,200 was appropriated for 408 works. The largest annual appropriation was $25,136,300, in 1890, for 436 separate works. The total amount expended in river and harbor improvements in these 74 years, 1820-1894, is $262,845,900. From the amounts already appropriated in the present decade, it is fair to assume that the period 1890-1900 will represent an expenditure of fully $200,000,000.

The work of planning and executing this work on rivers and harbors is in the hands of the Corps of Engineers of the U. S. Army, which is practically a bureau of the War Department, with the Secretary of War at its head. For this purpose the whole country is divided into five divisions, viz., the Pacific, Northwest, Southwest, Northeast and Southeast. Over each of these divisions is placed one of the senior officers of the Corps, usually with the rank of Colonel, and acting in the capacity of Supervising Engineer. These five divisions are further divided into from 45 to 50 districts, each in charge of an officer of the Corps known as the local Engineer-in-Charge. The official head of the Corps is the Chief of Engineers, with the rank of Brigadier-General.

Plans and projects for improvements, with estimates of cost, and also all reports or surveys called for by Congress, are submitted by the local Engineer of a district to the Supervising Engineer of the division, and by the latter transmitted to the Chief of Engineers, with such comments as he sees fit to make. About 77 officers of the Corps of Engineers, exclusive of the Chief of Engineers, are now engaged upon the work of river and harbor improvement in the United States. These officers are assisted by a large corps of civilian engineers.

Mr. Schermerhorn then touches upon some of the leading principles developed by legislation in connection with the navigable waters of this country. Although the policy of improving our navigable waters by government appropriations dates back to nearly the beginning of this century, the right of the government to conserve and control its navigable waters has been fixed by laws enacted mainly within the last 10 years. The government now takes the general position of broadly denying

TABLE III.—Cost of Pumping Water in Seven Cities of the United States in 1893.

Name of station.	Total coal used, 1 = 1,000 lbs.	Total pumpage, 1 = 1,000,000 gallons.	H'd against pumps, ft.	Duty, 1 = 1,000,000 ft.-lbs.	Coal used pr. mill. galls. per ft. h'd, lbs.	Ave. price coal used, per ton.	Comparison of cost, in cents, of pumpage per mill. gallons. per ft.-head, on uniform basis: Head = 200 ft.; coal at $2 per ton. Sal-aries.	Oil & stores.	Maintnc. re-pairs.	Coal.	Total cost.
Chicago:											
North Side	43,707	22,544	108.6	46.7	17.840	$5.69 Ant. 3.07 Blt.	1.106	0.058	0.150	1.784	3.098
West Side	32,489	19,271	104.2	51.5	16.180	2.82	1.208	0.048	0.192	1.618	3.066
Central	15,005	11,359	105.1	66.4	12.560	3.10	1.464	0.058	0.092	1.256	2.870
Lake View	9,297	4,600	108.0	44.6	18.720	3.15	2.500	0.170	...	1.872	4.542
14th St.	17,829	15,501	120.4	87.3	9.560	5.40 Ant. 3.12 Blt.	1.712	0.102	0.154	0.956	2.924
68th St.	22,595[1]	12,881	133.5	63.5	13.140	....	1.708	0.086	0.066	1.314	3.174
Whole city	140,920	86,156	113.0	57.6	14.480	....	1.467	0.075	0.132	1.448	3.122
Pittsburg, Brilliant	114,118	14,184	400.0	41.5	20.114	1.12	1.048	0.134	0.340	2.011	3.533
Philadelphia:											
Fairmount station	.....	9,912	100.0	....	Water pr.	....	0.411	0.025	0.286	...	...
Spring Garden (old and new)	98,388	39,006	150.6	49.9	16.710	1.73	0.655	0.051	0.577	1.671	2.954
Belmont station	27,584	6,361	220.4	42.4	19.676	1.73	1.227	0.080	0.577	1.968	3.852
Roxborough station, main	38,704	5,222	349.0	39.3	21.222	2.04 Av.	1.300	0.203	0.853	2.122	4.478
" " auxiliary	..	16	83.2								
Frankfort station	16,278	4,107	209.9	44.2	18.880	1.74	1.226	0.154	1.088	1.888	4.356
Boston:											
Chestnut Hill[2]	4,210	3,511	126.7	88.1	9.464	4.75 to 5.30 Blt.	1.673	0.097	0.283	0.946	3.000
Mystic	9,188	4,074	140.4	55.2	15.097	4.12 to 4.45	1.346	0.106	0.442	1.510	3.404
Louisville:											
Station No. 1, E. engine	.....	1,082	174.7	48.4	....	....	...	...	...	...	...
" " 1, W. "	.....	1,124	173.9	48.0	....	....	...	...	...	...	...
" " 1, " "	.....	311	175.8	24.3	....	....	...	...	...	...	...
" " 1, N. "	.....	224	175.8	25.2	....	....	...	...	...	...	...
New station, No. 3 engine	.....	2,144	179.1	92.6	....	....	...	...	...	...	...
River bank pumps	.....	7	181.1	26.8	....	....	...	...	...	...	...
Combined operations	13,315	4,801	176.6	54.1	15.418	2.42	1.629[3]	0.147	0.636[3]	1.542	3.951[3]
Cleveland:											
Division St.	62,316	15,390	192.6	39.7	21.018	1.42	1.329	0.104	0.281	2.102	3.816
Fairmount	2,223	639	162.4	38.9	21.422	1.19appr.	3.217	0.269	0.378	2.142	6.006
Milwaukee:											
North Point	12,211	9,116	161.7	100.6	8.220	5.45 Ant.	1.121	0.098	0.082	0.822	2.122
High-service engines	1,648	1,934	80.8	79.1	10.544	5.45 Ant.	2.246	0.393	0.065	1.054	3,758
Combined operations	13,859	11,051	.....	98.1	8.59	5.45	1.318	0.150	0.079	0.850	2.397

[1] Coal equivalent to oil burned; 1 gallon of oil assumed as equal to 10.435 lbs. coal, corresponding to 14 lbs. evaporation for oil and 8.75 lbs. for coal; oil at 6½ cts. per gallon.
[2] Evaporation equals 11.63.
[3] Above the usual cost. The total should be about 3.23, according to Mr. Charles Hermany, Superintendent.

the right of any individual, corporation, municipality, city or state to, in any manner, interfere with the free and safe navigation of any navigable waters of the United States, without the consent and authority of the government. No bridge can be built across, or abutments be placed in such waters without the approval of the Secretary of War upon specific plans and location submitted to him. This supervision regulates the length of fixed spans, width of draw-openings, clear height and position of abutments. After the bridge is completed the same authority prescribes rules and regulations governing the opening of draws, and imposes fines and penalties for their infraction. Old bridges obstructing navigation must be altered upon notice from the Secretary of War; and even the passage of rafts must be made as easy as possible. Water, gas or oil pipes, in the beds of navigable streams, are also subject to the control and authority of the Secretary of War.

The Secretary may establish harbor lines beyond which no piers or wharves shall extend and no deposits may be made, except under such regulations as he may fix. He can declare unlawful and can require the removal of any structures so placed as to obstruct or impair navigation, and he can fix the limits, in mining districts, within which debris may be deposited from mines. In fact, any alteration or modification of the natural capacity of any navigable water is forbidden, without the previous authority of the Secretary of War, even though such alteration or modification might improve such waters. The government can destroy and remove any wreck left for 60 days, where it will obstruct or endanger navigation, and the owner has no claim for damages arising from such destruction.

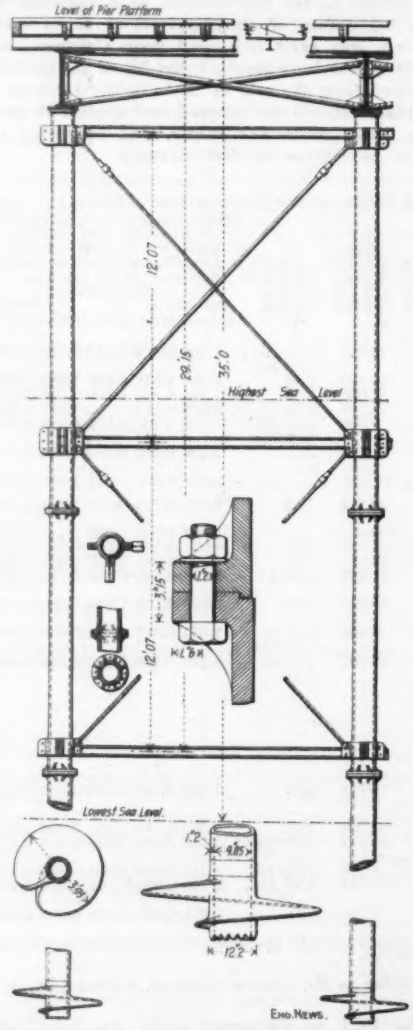
It is unlawful by Act of Congress for any one to build upon, alter, injure, or impair, in any manner, the usefulness of any sea-wall, bulkhead, jetty, dike, levee or other construction, or to remove or change any boundary mark, gage, surveying station, buoy or other established marks of the United States. The government, in improving any navigable stream, may close subsidiary channels, divert the natural flow into new positions and fill areas behind bars and islands, without incurring liabilities to riparian owners. It also has the right of eminent domain in acquiring land and other property necessary for the improvement and can acquire title by condemnation proceedings. Though the laws upon these heads are of recent enactment, the government claims that the right in each case was always latent in that provision of the Constitution which gave Congress "the right to regulate commerce among the states."

As to what has been accomplished, it may be said that in 1858, when the "Great Eastern" reached these shores, drawing 25 ft. of water, the only harbor in the United States that she could enter at low tide was that of Portland, Me. Lately, the steamships "St. Louis" and "St. Paul," with a loaded draft of 27 ft., were built and launched at Philadelphia. Thirty years ago the dimensions and draft of ocean vessels coming to our great seaports were such as to demand only 18 to 22 ft. of an entrance depth at low water; now our channels and harbors must be from 30 to 35 ft. deep, to meet modern requirements. Mr. Schermerhorn concluded with a long list of prominent government works with most of which our readers are generally familiar.

SCREW PILING FOR A PIER AT BLANKENBERG, BELGIUM.

Screw piling is very commonly used in Europe for piers and landing places on the coast. At Blankenberg, Belgium, a seaside resort about 15 miles from Ostend, it has recently been used as the foundation for a new pier 1,033 ft. long from the masonry abutment and 29 ft. 6 ins. wide. At the middle of the pier is a platform of elongated octagonal form, 96 ft. 10 ins. long and 78 ft. 9 ins. wide, while at the sea end is a similar platform, 210 ft. by 197 ft., on which is a pavilion with restaurant, band stand, etc. The pier is supported by bents of six piles each, the piles of each bent being 13.12 ft. apart (or 26.24 ft. c. to c. of outer rows), and the bents 35.3 ft. apart. The platforms are supported on piles spaced 13.12 ft. apart longitudinally and transversely. The piles are sunk in the sand to depths of 11.5 ft. to 16 4 ft., and the bents have diagonal bracing in each panel.

There are 313 piles, all 11.7 ins. outside diameter, and from 9.36 to 9.75 ins. inside diameter, the thicker piles being used in deep water and for the outside rows. The bottom length of the pile carries the screw blade, 3.93 ft. diameter and 5.3 ins. pitch, while below the blade the bottom of the pile is formed with teeth to cut into the substratum. The horizontal bracing of the bents is of steel I-beams, 5 × 4½ ins., and the diagonal bracing is of 1⅜-in. round rods, fitted with turnbuckles. The I-beams and rods are attached to cast iron collars bolted to the piles, and the I-beams are weakened



Part Cross Section of Screw Pile Pier at Blankenberg, Belgium.

by having the flanges cut away at these collars. The flooring is carried by three lines of plate girders, except at the central and end platforms, where single or double rows of I-beams are used. On the girders are transverse floor beams of 7-in. I-beams, to which are fastened 16 rows of wooden beams 9 × 3¼ ins., to which the 1½-in. floor planks are spiked.

The piles are sunk mainly into the sand, passing through some layers of peat and clay, the latter being very stiff and offering great resistance to the pile. A powerful water jet was discharged from the bottom of the pile during sinking, and the screwing was done by steam plant. The piles at the end of the pier are 52.5 ft. long, with 36.08 ft. above ground. The low-water level is 13 ins.; mean level, 7 ft.; high-water, 13.75 ft., and pier platform, 35 ft. above mean sea level at Ostend. The writer of the article in the "Engineer," of London, from which our description and illustration are taken, thinks that some of the piles at the sea end should have been filled with cement concrete to increase their stability.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Dedication of a Street.

Making a map of land and designating an avenue thereon, and, in a deed of part of the land describing it as bounded by such an avenue, as designated on the map, is a dedication to the public, without a statement that by avenue was meant a public street.—People v. Underhill (Ct. App. N. Y.), 39 N. E. Rep., 333.

Grant to Rival Street Railway Companies to Use Streets.

A street railway company is not entitled to equitable relief, in respect to streets, for its occupation of which it had not obtained the consent of the city, but as to streets occupied by it with such consent, the power of the city to make new contracts was not intended as a repeal of franchises of existing companies, and such new company should be enjoined from running its cars on the old company's tracks, or laying its rails so as to prevent or needlessly impede the running of the old company's cars.—Citizens' St. R. R. Co. v. City Ry. Co. (U. S. Cir. Ct., N. Dist. Ind), 64 Fed. Rep., 648.

Priority of Right of Street Railway Companies.

A consent given by the local authorities to a company named, prior to the incorporation of such company under such act, to construct a road on a certain street, could not become effective after such incorporation, as against another company which incorporated before the former company, and within a reasonable time afterwards obtained such consent to construct a road on the same street.—Homestead St. Ry. Co. v. Pittsburg & H. Elec. St. Ry. Co. (Supr. Ct. Pa.), 30 At. Rep., 950.

Right of One Railway to Intercept Another.

The right of one railway company to intersect the track of another is not subject to the objection that it is taking land already dedicated to public use.—Hornellsville Elec. Ry. Co. v. N. Y., L. E. & W. R. R. Co. (Sup. Ct., 5th Dept.), 31 N. Y. S. Rep., 745.

Eminent Domain—Damages to Contiguous Property.

Where a railway company seeks to condemn land adjoining a street, the fee of which is in the city, the owner of such land cannot recover damages that will be caused to other property of his, situated on the opposite side of the street, though bought in order to be used in connection with the property taken, if not so used when the condemnation suit is brought.—White v. Met. W. S. El. R. R. Co. (Sup. Ct. Ill.), 39 N. E. Rep., 270.

Damages for Noise of Elevated Railway.

A church cannot recover damages for noise made by the operation of an elevated railway in the street on which the church abuts, as its easements in the street are those of light, air and access; but it has no easement of quietude, and it is immaterial that its title extends to the center of the street.—S. & B. B. El. R. R. Co. v. S. F. Reformed Dutch Church (Sup. Ct., 2d Dept.), 31 N. Y. S. Rep., 63.

Evidence as to noise caused by the operation of an elevated railway in the street on which the property of a party abuts is competent as to past damages to the premises.—Diehl v. Met. El. Ry. Co. (Superior Ct. N. Y. City), 31 N. Y. S. Reporter, 839.

Damages to Abutters on Elevated Railway.

Proof that abutting property is of greater value since than it was before the construction of an elevated road will not defeat recovery of damages; but must be taken in connection with other findings that other property in that vicinity had increased with the growth of the city, and not by reason of the placing of the road.—Schmidt v. Manhattan Ry. Co., 31 N. Y. S. Rep., 832.

In an action for damages to abutting property caused by the operation of an elevated railway, where the evidence showed that the rents steadily decreased until the operation of the road began, and steadily increased afterwards, notwithstanding the invasion of the premises by cinders, smoke, steam and odors emitted by the engines, and the interference with light and drippings of the railway structure, the complaint was properly dismissed on its lack of merit.—Israel v. Metro. El. R. R. Co., 31 N. Y. S. Report, 816.

Presumption as to Boundaries in Making Surveys.

Where there is no evidence as to how surveys were made, the presumption of law is that they were actually made on the ground, as required by the law, and this presumption cannot be silenced by the mere opinion of a surveyor who testifies that he does not think they were so made.

Where a surveyor makes a mistake in supposing that he has reached the western lines of an older survey when running the course and distance called for, the calls for course and distance should control in locating the boundary.

Where the lines of older surveys as called for cannot be identified by anything found on the ground, they must be ascertained by running course and distance from other corners of the surveys.—Ark. Pass Colonization Co. v. Flippen (Ct. Civ. App. Tex.), 29 S. W. Rep., 813.

Damages Against City for Changing Grade of Street.

In assessing the damage to property caused by the grading of a street, benefits and injuries to the property should be considered, though every lot on the street is benefited or injured in the same manner, as such benefits are different from those in common with the community in general.

Where the property injured is the residence and homestead of the owner, benefits arising from its increased value for business purposes cannot be considered in diminution of damages.

Statutes providing for the assessment of damages for property taken by a city for a public use do not determine the benefits and injuries to be considered in case of damage to property, as in the case of the grading of the street.—City of Dallas v. Kahn (Ct. Civ. App. Tex.), 29 S. W. Rep., 98.

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PERSONALS.

Mr. William E. King, of Ledgewood, N. J., has been elected Engineer of the Morris County Board of Freeholders.

Mr. H. F. Gettleman has been appointed Engineer and Master Mechanic of the Pennsylvania Plate Glass Co., of Irwin, Pa.

Mr. Frederick Seymour has been appointed Superintendent of the Westchester County Water-Works Co., at Mount Vernon, N. Y.

Mr. Camille Mercader, of the Edgar Thomson Steel Works, Bessemer, Pa., has been appointed manager of the government steel works at Buda-Pesth, Austria.

Mr. W. H. V. Reimer has been appointed Street and Sewer Commissioner of East Orange, N. J., under the new law, which establishes this office in place of that of Township Engineer.

Lieut.-Col. P. C. Hains, U. S. Engineer Corps, has been appointed to succeed Gen. Craighill in charge of the river and harbor works of Maryland, Delaware, Virginia and West Virginia, with offices at Baltimore, Md.

Mr. Charles C. Poe, son of Gen. O. M. Poe, U. S. Engineer Corps, died in this city May 18, at the age of 30. He was manager of the Jersey Water Co., of New York, and was formerly in the engineering department of the Michigan Central R. R.

Mr. T. C. Clarke, M. Am. Soc. C. E., has resigned his position as Engineer of the New York State Commission appointed to locate the New York and New Jersey bridge, and has also resigned his position as Chief Engineer of the New York & New Jersey bridge companies.

Mr. Martin Schenck, formerly State Engineer and Surveyor of New York, has been appointed City Engineer of Troy, N. Y. He was born in 1845, graduated at Union College in 1869, and was engaged on railway and hydraulic engineering until 1883, when he entered the engineering department of the state canals. He was elected State Engineer in 1891.

Mr. J. B. Rohrer, who has been connected with the preparation and construction of the Main Channel of the Sanitary District of Chicago for more than three years, has resigned the position of Sub-Assistant Engineer, in order to join the contracting firm of Hiero B. Herr & Co., of Chicago. His address will be 1623 Monadnock Building, Chicago, Ill.

Mr. Ralph Modjeski, M. Am. Soc. C. E., 1334 The Monadnock, Chicago, has been engaged as Consulting Engineer by the Chicago, Rock Island & Pacific Ry. to design a new bridge to be built over the Mississippi River between Rock Island, Ill., and Davenport, Ia., to replace the existing structure. It will be a double-track railway and highway bridge of the double-decked type. The same general arrangement of spans will be used as in the present structure. It will be about 2,000 ft. long and will have a draw span 370 ft. long.

Mr. D. C. Dunlap, M. Am. Soc. C. E., has been appointed Chief Engineer of the Valley Terminal Ry., with headquarters at Appleton, Wis. He has had over 20 years' experience, 13 years of which have been with various railways, among them the Chicago & Northwestern Ry. and Chicago, Milwaukee & St. Paul Ry., the remainder of the time being spent in municipal and hydraulic engineering. He was for three years City Engineer of Rockford, Ill., during which time several important works were carried out, and was for about the same period with the Sanitary District of Chicago, as Assistant Chief Engineer and Assistant Superintendent of Construction.

The American official representatives at the International Railway Congress in London in June will include delegates from the American Railway Association and delegates from the railway companies which are members of the permanent organization of the Congress. The delegates from the American Railway Association are as follows: Henry S. Haines, President of the American Railway Association and Vice-President of the Plant System; Wm. F. Allen, Secretary of the American Railway Association; Jas. T. Harahan, Second Vice-President of the Illinois Central R. R.; Chas. W. Bradley, General Superintendent of the West Shore R. R.; Jacob J. Frey, General Manager of the Atchison, Topeka & Santa Fe R. R.; Theodore Voorhees, First Vice-President of the Philadelphia & Reading R. R.; John R. Kenly, General Manager of the Atlantic Coast Line; Alfred Walter, President of the Delaware, Susquehanna & Schuylkill R. R.

The representatives of individual railway companies will include the following:

New York, New Haven & Hartford R. R.—Chas. P. Clark, President; F. S. Curtis, Chief Engineer; C. H. Platt, General Superintendent, New Haven System; E. G. Allen, General Superintendent, Old Colony System; John Henney, Jr., Superintendent of Motive Power; S. A. Gardner, Superintendent of the Fall River Line; C. C. Elwell, Engineer of Maintenance of Way, New York Division; J. G. Parker, Secretary of Delegation.

New York Central & Hudson River R. R.—John M. Toucey, General Manager.

Nashville, Chattanooga & St. Louis Ry.—J. W. Thomas, Jr., Assistant General Manager.

Pennsylvania R. R.—Frank Thomson, First Vice-President; James McCrea, First Vice-President, Lines West of Pittsburg; Theo. N. Ely, Chief of Motive Power; Jas. L. Taylor, General European Passenger Agent.

Los Angeles Terminal Ry.—Geo. B. Leighton, President; and possibly, D. L. Barnes, Consulting Engineer.

Fitchburg R. R.—Henry S. Marcy, President; Wm. L. Chase, Director.

Lehigh Valley R. R.—Charles Hartshorne, Vice-President; Rollin H. Wilbur, General Superintendent.

It is also understood that the Denver & Rio Grande R. R. will send representatives, and that the New York Central R. R. will be represented by Walter Webb, Third Vice-President, and William Buchanan, Superintendent of Motive Power, but these are not officially announced.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERING CLUB OF COLUMBUS, O.
June 1. Secy., David Buell.
ENGINEERS' CLUB OF PHILADELPHIA.
June 1. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
June 3. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 5. Discussion on "The Santa Ana Irrigation Canal" Annual meeting at Nantasket, Mass., June 18. Secy., C. W. Hunt, 127 E. 23d St., N. Y. city.
ENGINEERS' CLUB OF ST. LOUIS.
June 5. "Water Towers at Laredo, Tex., and St. Charles, Mo.," by Edward Flad. Secy., W. H. Bryan, Turner Block.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 7. Secy., O. H. Von Geldern, 819 Market St., San Francisco.
MONTANA SOCIETY OF CIVIL ENGINEERS.
June 8. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
June 8. Secy., C. C. Brown, City Engineer.
ENGINEERS' CLUB OF KANSAS CITY.
June 10. Secy., F. W. Tuttle, Baird Building.
MASTER CAR BUILDERS' ASSOCIATION
June 11. Annual Convention at Alexandria Bay, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago, Ill.
NORTHWESTERN SOCIETY OF ENGINEERS.
June 11. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 11. Secy., F. A. Coburn, Case Library Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
June 11. Secy., H. Breen, 36 Jacobson Block.
WISCONSIN POLYTECHNIC SOCIETY
June 11. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
ASSOCIATION OF RAILWAY TELEGRAPH SUPTS.
June 12. Montreal, Que. Secy., P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 13. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
June 13. Secy., H. D. Ruhm, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Mecker, St. Paul, Minn.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 17. Annual Convention at Alexandria Bay, N. Y. Secy., Angus Sinclair, 256 Broadway, New York city.
ENGINEERS' CLUB OF MINNEAPOLIS.
June 17. Secy., E. Nexsen, Kasota Block.
COLUMBIAN ENGINEERING SOCIETY.
June 18. Secy., W. F Hart, University Building, 15th and H Sts. N. W., Washington, D. C.
NATIONAL ASSOCIATION OF CAB SERVICE MANAGERS.
June 18. At Cleveland, O. Secy., A. G. Thomason, Scranton, Pa.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
June 19. Secy., F. Van Vleck, Los Angeles, Cal.
WESTERN SOCIETY OF ENGINEERS.
June 19. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
BOSTON SOCIETY OF CIVIL ENGINEERS.
June 19. Secy., S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 20. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
June 20. Secy., J. F. Wilson, Odd Fellows' Temple.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 22. to 28. Annual Convention at Detroit, Mich. F. R. Hutton, Secy., 12 W. 31st St., New York city.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 25 to 28. At Niagara Falls, N. Y. Secy., R. W. Pope, 26 Cortlandt St., N. Y.
INTERNATIONAL RAILWAY CONGRESS.
June 26 to July 10. At London, England. Secy., F. Weissenbruch, Brussels, Belgium.. Secy. of English Branch, W. M. Acworth, London, England.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on May 18, Mr. Joseph Kemper read a description of the temporary repair of the Cincinnati, Hamilton & Dayton R. R. bridge at Connersville, Ind. The bridge was a combination Warren through-truss structure, with three spans of 165 ft., and the two end spans were knocked down by a collision of freight trains on the bridge July 15, 1892. A temporary track was laid, which descended a steep grade to the dry river bottom, and on the other side connected with an old gravel track, up a steep grade to the main track. The greater part of the trestling was of very shallow depth, at its lowest point the stringers resting only on well-bedded mudsills. The erection was done without the aid of instruments, the curve being an excellent specimen of a track foreman's skill in "lining up." The work of clearing the wreckage away from between the bridge-piers was then begun, and trestles similar in construction to those of the temporary road were made and put up on the gravel bottom at the Connersville end of the bridge. At the southeast end the distance from the base of the rail to the water-level was about 22 ft. The tops of the old piles used as falsework where the broken truss had first been built were sawed off to a level, and the bent rested upon them. The time occupied in the entire work, including the temporary trestling and the work of replacement on the old line of the bridge, was about five days.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The annual meeting was held on May 22. Reports were presented showing a total membership of 944. The following officers were elected: President, Dr. Louis Duncan, of Baltimore; Vice-Presidents, Dr. Michael I. Pupin, of New York city; W. F. C. Hasson, of San Francisco, and Angus S. Hibbard, of Chicago; Managers, Carl Hering, of Philadelphia; Bion J. Arnold, of Chicago; Charles F. Scott, of Pittsburg, and Cary T. Hutchinson, of New York city; Treasurer, George A. Hamilton, of New York city. The general meeting will be held at Niagara Falls, N. Y., June 25 to 28.

WESTERN RAILWAY CLUB.—The annual meeting of the club for the election of officers was held at the Auditorium Hotel May 21, and the following officers were elected: President, Mr. G. F. Potter; First Vice-President, D. L. Barnes; Second Vice-President, A. M. Waitt; Treasurer, J. N. Barr. These officers, together with the secretary, who, according to the new constitution of the club, is appointed by the executive committee, and one member elected from the club, will constitute the executive committee. The member of the executive committee elected was Mr. P. H. Peck. At this meeting a new and much improved constitution, as noted above, was adopted. Previous to the election of members there was a vigorous discussion on the question of car heating. We shall give some part of this discussion in a future issue.

NEW PUBLICATIONS.

REPORT OF THE BOARD OF RAILROAD COMMISSIONERS OF THE STATE OF OREGON.—Fourth Biennial Report to the Legislative Assembly, 1895. Published by the Commission, Salem, Ore. 8vo.; pp. 386.

The bulk of this report is taken up with the detailed tabular returns of the several railways, no attempt being made to summarize or digest the figures presented. There are also notes on the rate question, the annual inspections and the complaints as to rates and other matters.

REPORTS AND BULLETINS OF THE CALIFORNIA STATE MINING BUREAU.—Published by the Bureau, San Francisco, Cal., under the direction of J. J. Crawford, State Mineralogist.

In consequence of the extensive demand by non-residents of California for the publications of this bureau (some of which have been reviewed in our columns), the Board of Trustees has found it necessary to institute a scale of charges to cover the expense of printing, postage, etc., as follows: Reports: Nos. 6, 7, 8, 9 and 12 (for 1886, 1887, 1888, 1889 and 1894 respectively), $1 each; Report No. 11, 1892, 50 cts. Bulletins: No. 2, "Mine Timbering," 50 cts.; No. 3, "Gas and Petroleum," 50 cts.; No. 4, "California Fossils," 25 cts.; No. 5, "Cyanide Process," 50 cts.

L'OR A MINAS GERAES (BRESIL). Vol. II. Etude publiee par les soins de la Commission de l'Exposition Preparatoire de l'Etat de Minas Geraes, a Ouro Preto, a l'occasion de l'Exposition Miniere et Metallurgique de Santiago, Chili, en 1894. Par M. Paul Ferrand, Ancien Eleve de l'Ecole Nationale Superieure des Mines de Paris, etc. Ouro Preto, Brazil. Officially printed by the State of Minas Geraes. 8vo; pp. 141; illustrated.

This volume is devoted to a detailed description of the Passagem Mine, belonging to the Ouro Preto Gold

Mining Company, Limited, and is selected as the most important of the four gold mines owned by this company in the state of Minas Geraes, in Brazil. The geographical and geological conditions are explained, along with the history of operation, from 1729, and the methods of extraction and reduction adopted.

TESTS OF AUTOMATIC SPRINKLER HEADS. By Prof. D. S. Jacobus, Stevens Institute of Technology, Hoboken, N. J. Published by the author. Second paper. Paper; 8vo; pp. 10.

This pamphlet, reprinted from the "Stevens Indicator," is a discussion of tests of automatic sprinkler heads made in the department of tests of the Stevens Institute. A paper on this subject was read by Prof. Jacobus before the Section of Engineering and Mechanics of the American Association for the Advancement of Science, at the Brooklyn meeting last fall. In the present paper additional tests are described. The investment in automatic sprinklers for fire protection now reaches millions of dollars, and the account of these Stevens Institute tests is by all odds the best literature in existence relating to the design and efficiency of these sprinklers.

THE TECHNOGRAPH.—No. 9, 1894-95. Published by the Engineering Societies of the University of Illinois, Champaign, Ill. Paper; 8vo.; pp. 182; illustrated; 50 cts.

This volume contains the following papers: "Efficiency Tests of the Urbana & Champaign Electric Railway," C. H. Trego and O. E. Goldschmidt; "Railway Crossing Frogs," W. D. Pence; "Strength of Ice," C. W. Beach, A. M. Munn and H. E. Reeves; "Bread-and-Butter Side of Architecture," C. H. Blackall; "System in a Technical School Shop," W. H. Van Dervoort; "Mathematics and Construction in the Ecole des Beaux Arts," J. M. White; "Experiments on the Design of Electro-Magnets," W. Estey; "Washington Fir," G. W. Bullard; "The Proximate Analysis of Coal," S. W. Parr; "Notes on Cement Laboratory Work," I. O. Baker; "Tests of Babcock & Wilcox Boilers," R. A. Wood; "Hints Relating to the Practice of Railway Surveying," A. C. Schwartz; "Test of a Heating System," L. P. Breckenridge; "The College of Engineering," W. R. Morrison and P. Junkersfeld.

PAPERS READ BEFORE THE ENGINEERING SOCIETY OF THE SCHOOL OF PRACTICAL SCIENCE, TORONTO. Session, 1894-95.—Published by the Society. Librarian, F. W. Guernsey. Paper; 8vo; pp. 253; illustrated.

This volume contains the following papers: "Grading," W. L. Innes; "The Maintenance of English Roads," Sidney M. Johnson; "Vise Work," G. M. Campbell; "The Country Roads of Ontario," John A. Duff; "Aerial Mechanical Flight," C. H. Mitchell; "Hirn's Analysis of Heat Distribution in the Cylinder of a Steam Engine," Edgar J. Laschinger; "The Ventilation of Sewers," W. F. Van Buskirk; "The Cleaning and Annealing of Castings," H. L. McKinnon; "The Canadian Dawn Animal," A. T. Tyre; "The Use of Asphaltum in Engineering Construction," Frank N. Speller; "The Hardening and Tempering of Steel," E. F. Shipe; "Gear Cutting," H. V. Haight; "The Finlayson Marine Pipe Boiler," Arthur E. Blackwood; "Sewage Disposal in Ontario," R. W. Thomson; "Power Switchboard and Dynamo Tending," Robert A. L. Gray; "Dynamo Design," E. B. Merrill; "Solutions," A. W. Connor.

TRADE PUBLICATIONS

ASPHALTUM PAINTS.—National Paint Works, Williamsport, Pa. Paper; oblong, 6¾ × 10 ins.; pp. 16; illustrated.

These works manufacture Elliot's asphaltum liquid paint in all colors for painting cars, wooden and brick buildings, bridges, roofs, structural ironwork, etc.

METAL TIE PLATES.—The Q. & C. Co., Chicago, Ill. Paper; 9½ × 6 ins.; pp. 24; illustrated.

This is a set of half-tone reproductions of the company's different forms of tie-plates, and of wooden ties unprotected by tie-plates, showing the cutting effect of the rails in the latter case.

MARINE ENGINES AND STEAM LAUNCHES.—Charles P. Willard & Co., Chicago, Ill. 8vo; pp. 32; illustrated.

This firm builds small steam-propelled pleasure craft, and engines and boilers for driving them. It makes a specialty of small compound engines and the Willard water-tube boiler.

WATER TUBE BOILER.—Economy Water Tube Boiler Co., 143 Liberty St., New York. Oblong, 9½ × 6½ ins.; pp. 36; illustrated.

The Economy boiler has a set of inclined tubes lengthwise of the furnace, with vertical tubes extending from the lower leader to the saddles of two horizontal steam drums, which are also lengthwise of the furnace. The tubes are 4½ ins. diameter, and some of the upper tubes have 2¼-in. circulating tubes inside.

ROLLED STEEL, BOLTS, ETC.—Colorado Fuel & Iron Co., Denver Colo. Pocket-book, 5¼ × 2½ ins.; pp. 28.

This little pocket-book contains handy tables of sizes, weights and prices of bars, angle irons, bolts and nuts, spikes, and also the number and weight of rails and fastenings per mile of track.

RAIL JOINT.—M. C. & S. S. Niles, 11 South Canal St., Chicago, Ill. Paper, 5¼ × 6¾ ins.; pp. 4.

The Niles joint consists of an L-shaped bridge plate, with a brace bar between the top of the plate and the bottom of the rail web, and a splice bar on the other side of the rail, all held together by ordinary track bolts.

ASBESTOS.—New Jersey Asbestos Co., Camden, N. J. Paper, 7½ × 9½; pp. 38; illustrated.

This is an illustrated catalogue and price list of asbestos tape, gaskets, packing, millboard, pipe covering, cloth, and other material, and contains several views showing the different processes of manufacture in the company's works.

SANDSTONE.—Allegheny Quarries, Lancaster, O. Oblong, 3¼ × 6¾; pp. 12.

This little pamphlet contains particulars of the Hocking Valley standstone, which is used for bridge abutments, tunnel portals, buildings, etc. Tests of 6-in. cubes by the P., C., C. & St. L. R. R. showed crushing strengths of 5,950 and 6,760 lbs. per sq. in.

AUTOMATIC ENGINES, MECHANICAL DRAFT, AND FORGES.—B. F. Sturtevant Co., Boston, Mass. 8vo; pp. 27, 20 and 50.

The first of these pamphlets contains descriptions and prices of the Sturtevant automatic upright engine for electric lighting plants, etc. The second shows different applications of the Sturtevant fan, and the third gives descriptions and prices of stationary and portable forges, blowers, blast gates, etc.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
May 31.	Pipelaying (50 miles), Advertised, Eng. News, May 9 and 16.	Syracuse, N. Y.	May 9
May 31.	Water-works system,	Whitehall, Wis.	May 9
May 31.	Pipe sewers (5,000 ft),	Findlay, O.	May 9
May 31.	Cement and sand,	Portland, Me.	May 16
	Advertised, Eng. News, May 16 and 23.		
May 31.	Artesian well,	Elmwood, Ill.	May 16
May 31.	School building,	Reading, Mass.	May 16
May 31.	Pipe sewers (17⅓ miles), Advertised, Eng. News, May 16 and 23.	Ann Arbor.	May 16
May 31.	Cement sidewalks,	Avondale, O.	May 23
May 31.	Court house,	Wilkes Barre, Pa.	May 23
May 31.	Highway bonds ($400,000),	Boston, Mass.	May 23
May 31.	Bridges & mas'ry,	Washington C. H., O.	May 23
May 31.	Boiler,	Newark, N. J.	May 23
May 31.	Court house,	Nanaimo, B. C.	May 23
June 1.	Electric lighting,	Vancouver, B. C.	Apr. 25
June 1.	Plans for cotton factory,	Weldon, N. C.	May 9
June 1.	Steel forgings, etc.,	Washington, D. C.	May 16
June 1.	Steam road roller, Advertised, Eng. News, May 16 and 23.	Toronto, Ont.	May 16
June 1.	Water-works system,	Postville, Ia.	May 16
June 1.	Brick paving,	Ashtabula, O.	May 16
June 1.	Concrete sidewalks, Advertised, Eng. News, May 16 and 23.	Dolgeville, N. Y.	May 16
June 1.	Grading,	Kansas City, Mo.	May 16
June 1.	Cement sidewalks,	Indianapolis, Ind.	May 23
June 1.	Asylum annex,	Goldsboro, N. C.	May 23
June 1.	Railway shops at Wabash,	Ind.	May 23
June 1.	Water bonds ($75,000),	Meadville, Pa.	May 23
June 1.	Fence (6,000 ft.),	Salt Lake City.	May 23
June 1.	Water bonds ($3,000),	Eveleth, Minn.	May 30
June 1.	Bridge abutments,	Waynesboro, Pa.	May 30
June 3.	Courthouse plans,	Winfield, W. Va.	Apr. 18
June 3.	Electric lighting,	Chattanooga, Tenn.	May 16
June 3.	Water bonds	College Point, N. Y.	May 16
June 3.	Powder for Benicia Arsenal,	Cal.	May 16
June 3.	Building,	Nebraska City, Neb.	May 16
June 3.	Court house,	Natchitoches, La.	May 16
June 3.	Pipe, valves, etc.,	Allegheny, Pa.	May 23
June 3.	Sewers, Auburn, N. Y. Advertised, Eng. News, May 23 and 30.		May 23
June 3.	Sewers,	College Point, N. Y.	May 23
June 3.	Sewers,	Washington, D. C.	May 23
June 3.	Electric lighting,	Asbury Park, N. J.	May 23
June 3.	Electric lighting, Advertised, Eng. News, May 23.	Washington, D. C.	May 23
June 3.	Sewer bonds ($100,000),	Brooklyn, N. Y.	May 23
June 3.	Road improvements,	Athens, O.	May 23
June 3.	Macadamizing,	Orange, N. J.	May 30
June 3.	Plans for clubhouse,	New York.	May 30
June 3.	Police station,	Philadelphia, Pa.	May 30
June 3.	Engine house,	Allegheny, Pa.	May 30
June 3.	Water ext'ns (2 miles),	Warsaw, N. Y.	May 30
June 3.	Electric lighting,	Darby, Pa.	May 30
June 3.	Sewers,	Brooklyn, N. Y.	May 30
June 3.	Granite block paving,	Albany, N. Y.	May 30
June 3.	Grading, etc.,	Laurel, Md.	May 30
June 4.	Right to cut timber,	Toronto, Ont.	May 9
June 4.	Cast iron pipe,	Toledo, O.	May 16
June 4.	Officers' barracks,	Omaha, Neb.	May 16
June 4.	Court house,	Zebulon, Ga.	May 16
June 4.	Grading, etc.,	Columbus, O.	May 23
June 4.	Grading,	New York, N. Y.	May 23
June 4.	Sewers,	Brooklyn, N. Y.	May 23
June 4.	Sewers,	New York, N. Y.	May 23
June 4.	Pipe sewers,	Buffalo, N. Y.	May 23
June 4.	Sewer,	Flushing, N. Y.	May 23
June 4.	Water-works system,	Juneau, Wis.	May 23
June 4.	Iron bridge, Advertised, Eng. News, May 23.	Boonton, N. J.	May 23
June 4.	Water tunnel work,	Buffalo, N. Y.	May 23
June 3.	School building,	Jersey City, N. J.	May 30
June 4.	Electric lighting,	Brooklyn, N. Y.	May 30
June 4.	Railway (4¾ miles),	St. Stephen, N. B.	May 30
June 4.	Street cleaning, etc.,	Washington, D. C.	May 30
June 4.	Paving and grading,	Philadelphia, Pa.	May 30
June 4.	Brick and asphalt paving,	Wilkes Barre.	May 30
June 4.	Earth excavation,	Wilmerding, Pa.	May 30
June 4.	School building,	Brooklyn, N. Y.	May 30
June 4.	Pipe sewers,	Troy, N. Y.	May 30
June 4.	Ventilating building,	Brooklyn, N. Y.	May 30
June 4.	Brick paving,	Uniontown, Pa.	May 30
June 4.	Garbage disposal,	Trenton, N. J.	May 30
June 5.	Bridges,	Cottonwood Falls, Kan.	May 9
June 6.	Foundation for lock,	New Orleans, La.	May 16
June 6.	Granite block paving,	Cincinnati, O.	May 16
June 6.	Public bld'g approaches at	Scranton, Pa.	May 23
June 6.	Tube well plant, Advertised, Eng. News, May 23 and 30.	Lowell, Mass.	May 23
June 6.	Resetting boilers,	Yonkers, N. Y.	May 23
June 6.	Smoke-preventing device, Advertised, Eng. News, May 23.	Rockford, Ill.	May 23
June 6.	Bridges,	Indianapolis, Ind.	May 23
June 5.	Retaining walls, etc.,	New York.	May 30
June 5.	Cement, etc.,	Washington Navy Yard.	May 30
June 6.	Laying water pipe (14 sts),	Chicago.	May 30
June 6.	Paving,	Brooklyn, N. Y.	May 30
June 6.	Granite block paving,	Cincinnati, O.	May 30
June 6.	Sand, stone, etc., Advertised, Eng. News, May 30.	Washington, D. C.	May 30
June 7.	Bridge,	Versailles, Ind.	Apr. 18
June 7.	Piers, etc., Advertised, Eng. News, May 9 to 30.	Detroit, Mich.	May 9
June 7.	Pipelaying, Advertised, Eng. News, May 16 and 23.	Syracuse, N. Y.	May 16
June 7.	State house,	Providence, R. I.	May 16
June 7.	Public building,	Rock Island, Ill.	May 16
June 7.	Paving materials,	St. Louis, Mo.	May 30
June 7.	Dredging (125,000 cu. yds),	Baltimore.	May 30
June 8.	Water-works franchise, Advertised, Eng. News, May 16 and 23.	Alexandria, Ind.	May 16
June 8.	Public bldg. approaches at	Galesburg, Ill.	May 30
June 8.	Trenching, etc,	Rumford Falls, Me.	May 30
June 8.	Electric lighting,	Greenville, O.	May 30
June 8.	Sewage pumping station,	Boston.	May 30
June 9.	Public bldg. work at	Taunton, Mass.	May 16
June 10.	Electric light plant,	Montreal Que.	May 9
June 10.	Building,	Faribault, Minn.	May 16
June 10.	Observatory,	Columbus, O.	May 16
June 10.	Interior of court house,	Rochester, N. Y.	May 16
June 10.	Armory work,	New York, N. Y.	May 23
June 10.	Water-works system, Advertised, Eng. News, May 23 and 30.	Forestville, N. Y.	May 23
June 11.	Brick paving (15,000 sq. yds.), Advertised, Eng. News, May 23 and 30.	Ithaca.	May 23
June 10.	Electric lighting,	Lansingburg, N. Y.	May 23
June 10.	Paving bonds,	Omaha, Neb.	May 23
June 10.	Street railway franchise,	Sacramento.	May 23
June 10.	Railway 9½ miles), Advertised, Eng. News, May 23 to June 6.	Rumford Falls, Me.	May 23
June 10.	Water bonds ($8,000),	Norwood, Mass.	May 23
June 10.	Water-tube boilers (4),	Chicago.	May 23
June 10.	Earth dams,	North Adams, Mass.	May 23
	Advertised, Eng. News, May 23 and 30.		
June 10.	Sewer bonds ($325,000),	Youngstown, O.	May 30
June 11.	Sewers,	New York, N. Y.	May 30
June 11.	Macadamizing,	Bound Brook, N. J.	May 30
June 11.	Roads,	Upper Sandusky, O.	May 30
June 11.	Laying water pipe (24 sts.),	New York.	May 30
June 11.	Water bonds ($11,400),	Hibbing, Minn.	May 30
June 12.	Public bld'g approaches at	Lewiston, Me.	May 23
June 12.	Metal work, Advertised, Eng. News, May 30.	Philadelphia, Pa.	May 30
June 12.	Lighthouse,	New Orleans, La.	May 30
	Advertised, Eng. News, May 30.		
June 13.	Wooden bridge,	Butte, Mont.	May 23
June 13.	Sewer,	Sterling, Ill.	May 30
	Advertised, Eng. News, May 30.		
June 13.	Foundations for beacons, Advertised, Eng. News, May 30 and June 6.	Cleveland.	May 30
June 14.	Stone and brick work at	Richmond, Ky.	May 23
June 14.	Bridge,	Central City, Neb.	May 23
June 14.	Water-works system, Advertised, Eng. News, May 23 to June 6.	Montgomery, N. Y.	May 23
June 15.	Irrigation canal,	Portland, Ore.	Apr. 18
June 15.	Sinking wells, Advertised, Eng. News, May 16.	Norfolk, Va.	May 16
June 15.	Water bonds,	Canandaigua, N. Y.	May 16
June 15.	Street improvements,	Avondale, O.	May 23
June 15.	Sewer, Emporium, Advertised, Eng. News, May 23.	Pa.	May 23
June 15.	Steel bridges (2 contracts), Advertised, Eng. News, May 23 to June 6.	London, Ont.	May 23
June 15.	Electric l't plant,	Scotland Neck, N. C.	May 30
June 15.	Railway (11½ miles),	Philipsburg, Pa.	May 30
June 15.	Brick paving,	Logansport, Ind.	May 30
June 15.	Iron cage,	Pulaski, Tenn.	May 30
June 17.	Building supplies,	Washington, D. C.	May 23
June 17.	Electric lighting, Advertised, Eng. News, May 23 to June 13.	Scottdale, Pa.	May 23
June 17.	Viaduct (642 ft.),	Albany, N. Y.	May 23
June 17.	Belgian block paving,	Jersey City, N. J.	May 30
June 17.	Steel viaduct,	Jersey City, N. J.	May 30
June 17.	Brick paving,	Jersey City, N. J.	May 30
June 18.	Paving, etc.,	Mattoon, Ill.	May 30
June 19.	Water-works system,	Pawhuska, Okla.	May 16
June 19.	Bridge mas'ry, (5 cont's),	Norristown, Pa.	May 23
June 19.	Steel bridge,	Ironton, O.	May 23
June 19.	School building,	Cleveland, O.	May 30
June 19.	Electric lighting,	Lexington, Ky.	May 30
June 19.	Sewers (6,500 ft.), Advertised, Eng. News, May 30.	Plainfield, N. J.	May 30
June 19.	Water-works,	Independence, Wis.	May 30
June 20.	Electric light plant,	Athens, O.	May 23
June 20.	Bridge bonds ($20,000),	Dayton, O.	May 23
June 20.	Fence,	Columbus, O.	May 23
June 20.	Electric light plant,	Los Angeles, Cal.	May 30
June 20.	Iron bridge,	Galveston, Tex.	May 30
June 20.	Court house,	Paris, Tex.	May 30
June 21.	Water-works system, Advertised, Eng. News, May 23.	Elmwood, Ill.	May 23
June 21.	Bridge superstructure,	Buffalo, N. Y.	May 30
June 21.	Iron bridge,	Cape Girardeau, Mo.	May 30
June 21.	Sewer,	Cincinnati, O.	May 30
June 24.	Court house plans,	Denton, Tex.	May 30
June 24.	Garbage disposal,	Washington, D. C.	May 30
June 26.	Court house and jail,	Swainsboro, Ga.	May 16
June 27.	Jetty work, Advertised, Eng. News, May 16 to June 6.	Montgomery, Ala.	May 16
July 1.	Water-works system, Advertised, Eng. News, May 30 to June 13.	Deckertown, N. J.	May 30
July 1.	Water-works system,	Cullman, Ala.	May 30
July 2.	Brick paving,	Van Wert, O.	May 30
July 2.	Water-w'ks franchise,	Greenville, Miss.	May 30
July 3.	Bridges,	Ukiah, Cal.	Apr. 18
July 6.	Jail cells,	Auburn, Cal.	May 16
July 8.	Courthouse, Advertised, Eng. News, May 9 to 23.	Baltimore, Md.	May 9
Aug. 2.	Electric lighting,	El Paso, Tex.	May 23
Aug. 5.	Plans for state capitol,	St. Paul, Minn.	Apr. 25
Oct. 1.	Plans for art building, Advertised, Eng. News, May 23 to June 27.	Philadelphia, Pa.	May 23
No date.	Engine and dynamos, Advertised, Eng. News, May 30 to June 20.	Newark, N. J.	May 30
"	Windmill pump,	Port Elgin, Ont.	May 30

RAILWAYS.

East of Chicago.

ALTOONA & PHILIPSBURG CONNECTING.—Bids are asked until June 15 for the construction of 11½ miles of railway. W. T. Forsythe, Ch. Engr. and Gen. Man., Philipsburg, Pa.

BANGOR & AROOSTOOK.—A new survey of the Ashland branch has been commenced under the direction of W. Z. Earle, Prin. Asst. Engr. The branch will be 42 miles in length, and a subsidy of $4,000 a mile was recently voted by Aroostook county, as noted in our issue of May 2. It is expected that the construction will be commenced at an early date. Pres., A. A. Burleigh, Houlton, Me.

BUFFALO & SUSQUEHANNA.—F. H. Goodyear, Chn. Bd., is reported as stating that over 500 men are at work on the extension between Galeton and Perryville, Pa., 25 miles. The purchase of the Wellsville, Coudersport & Pine Creek road, extending from Wellsville, N. Y., to Perryville, 12 miles, was noted in our issue of May 9. It is expected that through trains will be running between Wellsville and Galeton by Sept. 1, and there is talk that the line will be extended from Wellsville to Belfast, N. Y., and a direct connection be secured with Buffalo and Rochester by way of the Western New York & Pennsylvania.

CENTRAL NEW YORK & WESTERN.—Press reports state that this railway is to be made standard gage between Olean and Bolivar, N. Y., and a connecting link built from Bolivar to Angelica; also that surveys are being made for a line through Angelica, Birdsall and a part of Almond to Gas Springs. Ch. Engr., W. B. Parsons, 54 Wall St., New York.

CHICAGO & WEST MICHIGAN.—The contract for extending this railway to Turtle Lake, seven miles, as noted in our issue of May 16, is reported to have been awarded to McDonald Bros. & Co., of Grand Rapids, Mich., at $1,643 a mile, the work to be completed Aug. 15.

CLEVELAND, LORAIN & WHEELING.—This company filed a certificate May 21 for a branch from near its station in the township of Middleburg, Cuyahoga county, O., into the village of Berea, O. Ch. Engr., W. B. Hanlon, New Philadelphia, O.

CONCORD & MONTREAL.—It is reported at Manchester, N. H., that this company is likely to build the much-talked-of railway from Berlin to Errol Dam, on the lake, this summer. The company has had a charter for the same for a long time, and there is a general desire to have the road built this year. Ch. Engr., F. E. Merrill, Concord, N. H.

DETROIT & MACKINAC.—Daniel J. Kennedy, of Bay City, Mich., is reported as building a five-mile extension of this railway from Lupton, Ogemaw county, to timber lands owned by Briggs & Cooper, of Saginaw. It is stated that a narrow-gage line will be built from the end of this extension into the timber tract.

GLOVERSVILLE & BROADALBIN.—We are informed that the organization of this company was effected at Gloversville, N. Y., May 21, and the following officers elected: Pres., John H. Richardson, Gloversville; Secy. and Treas., Frank Burton, Gloversville; Supt. and Engr., J. W. Cleveland, Broadalbin. The railroad commissioners will consider the franchise on June 4.

HARDWICK & WOODBURY.—Geo. M. Powers, Pres., Morrisville, Vt., writes us that surveys have been completed and right of way secured for this railway from Hardwick to granite quarries in Woodbury, Vt., a distance of seven miles. It is hoped to negotiate the stock that remains unsold so as to commence the construction by June 15.

LAKE ERIE & DETROIT RIVER.—It is stated that there is a strong probability that this railway will be extended from the present eastern terminus, Ridgetown, to St. Thomas. The company already owns the London & Port Stanley railway. The connection between the two roads would give an unbroken line from Walkerville to London via St. Thomas, and a terminus on Lake Erie from which the company has already connection by boat with Cleveland. A few days ago officials of the company went to Ridgetown by train, and from there to St. Thomas by carriage. A petition is being signed by a large number in Ridgetown asking the provincial and dominion governments to grant a bonus for this extension. Pres., F. H. Walker; Man. Dir., E. C. Walker, both of Walkerville, Ont.; Ch. Engr., J. De Gurse, Windsor, Ont.

MAINE.—The residents of Limestone, Me., have appointed R. B. Leavitt, A. D. Hatfield, Geo. Phair and others a committee to secure a survey for a railway to connect this place with some existing railway.

MARION & NORTHWESTERN.—Geo. D. Copeland, Attorney, Marion, O., has drawn up incorporation papers for this company. Col. G. B. Christian, Judge C. H. Norris, Jas. S. Reed, Henry True and other residents of Marion, O., are interested.

MILLTOWN & ST. STEPHEN.—Bids will be received at St. Stephen, N. B., until June 4, according to reports, for the construction of this railway, 4¾ miles in length, to connect the Shore Line with the St. Croix & Penobscot.

MONCTON & BUCTOUCHE.—Dr. L. G. DeBertram, J. P. Harris, of Moncton, N. B., and Israel J. Merritt, I. J. Merritt, Jr., and Fredk. G. Pauley, of New York, have applied for a charter for this company, with a capital stock of $250,000. This is probably a reorganization of the Buctouche & Moncton. Gen. Man., E. G. Evans, Moncton, N. B.

NEW YORK, NEW HAVEN & HARTFORD.—A dispatch from New Haven, Conn., quotes an officer of this company as follows: In the case of the improvements to the road at its Boston entrance over the Providence division, the number of crossings to be eliminated is 16, and in all cases the tracks will be carried over the streets. The improvements begin at Forest Hill, and terminate in the Park St. station, in Boston. Four tracks, instead of three, will be constructed. The cost of the improvements will be $3,000,000, of which the road will pay 55% and the state and city the remainder. Some of the work is completed, and other large contracts, amounting to about $1,000,000, will be let in a short time. There will be no change in the terminal station, but several new suburban stations will be constructed, to conform with the elevated tracks. The work, which was begun at Stony Brook last fall, will be pushed to completion as rapidly as practicable. Another improvement is in the city of Brockton, where the grade crossings through the city are being eliminated and four tracks constructed. The total cost is to be about $1,500,000, of which 55% will be borne by the road. The company has also prepared plans for a roundhouse with 34 stalls, at New Haven, one with 10 stalls to be built at Wilson's Point, on the New York division, and one with 5 stalls to be constructed at New Milford, on the Berkshire division.

OHIO SOUTHERN.—It is stated at Ottawa, O., that this railway will soon be extended from Lima to that city, a distance of nine miles. Pres. and Gen. Man., G. W. Saul, Cleveland, O.

OLEAN, OSWAYO & EASTERN.—J. B. Ramsey, Pres., Oswayo, Pa., is reported as completing arrangements for building an extension of this railway from Genesee, Pa., through West Union and Greenwood to Canisteo, N. Y., 27 miles.

PITTSBURG & EASTERN.—It is reported that the following submitted bids last week for the construction of 14 miles of this railway, noted in our issues of April 11 and May 16: William Nolan, of Reading, Pa.; Thomas Ricketts, of Pottsville, Pa.; R. J. McGrann, of Lancaster, Pa.; ex-Senator King, of Schuylkill, Pa., and George S. Good, of Lock Haven, Pa.

SOUTHBRIDGE, STURBRIDGE & BROOKFIELD.—This railway has been projected for several years from Southbridge to Brookfield, Mass., 13 miles, and in March a new survey of seven miles of the line was made by L. M. Thacher, Cy. Engr., Northampton. About a year ago F. D. Fisk, Pres., 87 Milk St., Boston, opened bids for constructing the road, but no contracts were awarded. At the annual meeting May 15 several new propositions were made for building the road, and these are now being considered.

TORONTO, HAMILTON & BUFFALO.—A press report states that at a recent meeting held in the office of Chauncey M. Depew, Pres. New York Central, and attended by leading officials of that road, H. B. Ledyard, Pres. Michigan Central; Sir William Van Horne, Pres. Canadian Pacific, and J. H. Beckley, Pres. Toronto, Hamilton & Buffalo, an agreement was reached whereby this line is to be completed at once, and the three railways named will control it. It is understood that the Canadian Pacific will control that part of the new road between Toronto and Hamilton. A Hamilton, Ont., despatch also states that it is reported that a deal has been completed between the C. P. and M. C. by which the former takes over the Toronto, Hamilton & Buffalo and the M. C. in return is to have entrance to Toronto over the C. P. tracks. The truth of the report cannot be affirmed at present.

WATERVILLE & WISCASSET.—At an election June 3 Waterville, Me., will vote on a proposition to guarantee the interest on $50,000 of 10-year 5% bonds to aid in the construction of this railway from Waterville through Winslow, North and East Vassalboro, and China, to Week's Mills. Pres., I. C. Libby; Clk., Wm. T. Haines; Treas., Frank Redington, all of Waterville, Me.

Southern.

ALABAMA GREAT SOUTHERN.—The citizens of Gainesville, Ala., have offered to give $5,000 and 1,000 days' labor to secure an extension of this road from Epes north to that city, nine miles. The route has been surveyed, and the construction is estimated to cost $37,000. This is a part of the Queen & Crescent. Supt., A. J. Frazer, Birmingham, Ala.

AVON PARK TRANSPORTATION CO.—Clark D. Knap- Pres., Avon Park, Fla., writes us that this railway is projected from Avon Park, through Frostproof, Midland and Bartow, 40 miles. About one-half of the right of way has been secured, and it is expected to have the road in operation before next January. Large concessions of land are being secured along the route. Ch. Engr., J. C. Burleigh, Avon Park, Fla.

FERNANDINA WESTERN.—Samuel A. Swann, Pres., Fernandina, Fla., writes us that this railway is projected from Fernandina to Jasper, Fla., and Valdorta, Ga., 90 miles. Surveys are now being made and have been completed to Moniac Ferry, south of Okefenokee Swamp. The capital for construction is not entirely secured. No contracts will be awarded until the surveys have been completed and the engineers made their reports.

GAINESVILLE, ROCK POINT & MICANOPY.—It is stated that this railway will be extended to Brooksville, and the name changed to the Gainesville & Gulf. Pres., V. J. Heslory, Gainesville, Fla.

GEORGIA & TENNESSEE.—Organized by Thomas M. Barna, George H. Benning, ex-Gov. R. B. Bullock, and others, of Atlanta, Ga., to build a railway from Atlanta to a point in Murray county between the Georgia and Tennessee line, with a branch to Cartersville, Ga.; capital stock, $2,000,000.

MARIAN-BAD SPRINGS.—Bids are asked by this company, at Winston, N. C., according to reports, for building four miles of railway, laid with 35-lb. steel rails; also for two small narrow gage steam dummies and six or eight passenger cars.

NASHVILLE & MISSISSIPPI DELTA.—Subscriptions are being raised in Chickasaw, Calhoun and Grenada counties, Miss., to complete this railway, which the reports state was graded 18 years ago. Maj. H. L. Underwood, of Birmingham, Ala., proposes to complete the road from Okolona, Miss., to Birmingham, 76 miles, if 40,000 acres of land are donated.

SOUTHPORT & WESTERN.—E. B. Stevens, Vice-Pres., Southport, N. C., writes us that this railway is projected from Conway to Camden, S. C., 150 miles, but that no definite plans have yet been adopted, and no contracts have been awarded.

WATAUGA.—This company is reported to have applied for a charter in Tennessee to build a railway from a point on the Ohio River & Charleston in Washington county, near Watauga River, via Carter depot to Wautauga Point, thence up Gap Creek Carter county, through Rogers Gap, through the Little Doe River valley to the North Carolina state line; incorporators, Ernest Law, L. A. Barringer, Charles T. Thompson, Harry C. Chase and J. H. Barr.

Northwest.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—Press reports state that surveys have been commenced for an extension from Mitchell, S. Dak., west to Wheeler, on the Missouri River; also that surveys are being made for a line from West Superior, Wis., to St. Paul and Minneapolis, Minn. It is said that the route will be from West Superior to the headwaters of the St. Croix River, thence through Burnette county, crossing the river a little north of Taylors, and running on the Minnesota side direct to St. Paul.

DAVENPORT, CLINTON & EASTERN.—Surveys have been completed for this railway from Davenport to Clinton, Ia., 34½ miles, and contracts for the construction will be awarded about June 15. The road will pass through Gilberttown, Pleasant Valley, Le Claire, Princeton and Comanche. The grades are easy and there are few curves. The line will be laid with 70-lb. rails. Shops will be erected at Davenport, and contracts for locomotives and cars will be let in June. Pres., L. N. Downs, Davenport, Ia.

DE KALB & GREAT WESTERN.—E. C. Lott, De Kalb, Ill., writes us that the right of way has all been secured and grading is well under way. The line extends from De Kalb to Sycamore, six miles, and was noted in our issue of April 11. Pres. and Ch. Engr., Raymond Du Puy, 820 Temple Bld., Chicago.

DULUTH & NORTH DAKOTA.—Press reports state that the grading has been commenced on this railway, and that it is intended to complete the line between Thief River Falls and Olga this year. This road is projected by D. W. Hines and other well-to-do farmers in the vicinity of Drayton, N. Dak.

KEYSTONE BELT LINE.—Incorporated in South Dakota, according to reports, to build a belt line at Keystone; capital stock, $200,000; incorporators, David Sisk, Chicago, Ill.; Charles C. Patton, Hermosa, S. Dak.; Peter J. McMahon, Ernest W. Zahrendt, Keystone, S. Dak.

MARSHALLTOWN & DAKOTA.—Incorporated in Iowa to build a railway from Story City, on the Iowa Central, northwest via Fraser and Gowrie to Sibley, about 150 miles, and beyond. If local aid is voted it is said that the road will be built this year from Story City to Gourie, about 40 miles; capital stock, $2,000,000; incorporators, Hamilton Browne, of Boone, Ia.; Norman D. Fraser, of Chicago, and C. T. Messervey, of Fort Dodge, Ia.; principal office at Boone, Ia.

TERRE HAUTE, SAYLOR SPRINGS & MOUNT VERNON.—A press report from Saylor Springs, Ill., states that Dr. E. F. Scarife, Pres., has gone to St. Louis to employ a corps of engineers to relocate a portion of this line from West York, Ill., to Saylor Springs, so as to take in Newton, the county seat of Jasper county, and Ingraham, in Clay county. Also that it is currently reported that the Pennsylvania Co. is behind this project, and that construction will commence as soon as the surveys are completed and approved. Terre Haute wants this road, and many of its most prominent business men have pledged themselves to build the road from Terre Haute to West York, Ill., and bridge the Wabash River at West York.

WISCONSIN CENTRAL.—E. H. Abbott, Pres. and Treas., is reported as stating that this company intends to build a branch line from Greenwood, Clark county, direct to Chippewa Falls, Wis.

Southwest.

DENISON & NORTHERN.—The awarding of the contract for building the first section of this railway was noted in our issue of May 16. The company proposes to build 320 miles of road as follows: From Denison, Tex., northerly via Lehigh and South McAlester to Fort Smith, Ark.; a branch from a point 33 miles north of Denison west to Dougherty, Ind. T., on the A., T. & S. F., 43 miles, and thence west to Duncan on the C., R. I. & P., 52 miles further; a branch from South McAlester north to Sapulpa, Ind. T. The distance from Denison to Lehigh is 61 miles, of which 5 miles are in Texas. The contract for the line from Dougherty to Lehigh, where there are rich coal fields, a distance of 71 miles, has been let to McTighe & Co., of Memphis, Tenn., who have commenced the construction, and it is expected to complete this part of the line by Sept. 1. McTighe & Co will sublet a part of the work at Dougherty. The company has contracted with the Illinois Steel Co. for 7,000 tons of steel rails and the first instalment is to be shipped next week. Pres., O. H. Brown; Vice-pres., Newton B. Childs; Treas., J. A. Atkinson; Gen. Man., S. H. Bracey; all with offices in the Marquette Building, Chicago; Secy., P. F. Fairbanks, Denison, Tex.

GULF & INTERSTATE.—A press report from Topeka, Kan., states that Horace M. Dake, of Brookfield, Mo., has been appointed receiver of this company. The road is known as a Populist project, and is to extend from Galveston, Tex., to Bismarck, N. Dak. The line between Port Bolivar (opposite Galveston) and Beaumont, Tex., is partially built. It is reported probable that F. J. Close and other officers of the company will resist in the Texas courts this appointment of a receiver.

HOUSTON, MANVEL & VELASCO.—Preliminary surveys are being made, according to reports, for this railway, which is said to be projected from Angleton to Manvel, Tex.

KANSAS CITY & NORTHERN.—This company has been organized at Kansas City with a capital stock of $1,000,000, according to a press report, to secure an entrance into that city for three Eastern railways, two of which the report states are believed to be the Baltimore & Ohio and the Chicago & Northwestern. Negotiations for the use of the Chicago, Milwaukee & St. Paul bridge are said to be about completed.

KANSAS CITY, PITTSBURG & GULF.—Kansas City papers state that work on this railway is progressing rapidly and that the company intends to add 150 miles on the extension south from Siloam Springs, Ark., during 1895. Construction between Texarkana and Shreveport is also being pushed with all possible speed, and this section will be completed in 1895. As soon as the line is located north of Horatio work will begin upon that portion of the road, which requires 44 miles to connect it with the rest of the system, and give a through line from Kansas City to Shreveport, a total distance of 552 miles.

NEWPORT, BONNERVILLE & KANSAS CITY.—Incorporated in Arkansas to build a railway from Newport northeast to Bonnerville, about 35 miles; capital stock, $200,000; incorporators, J. D. Goldman, of St. Louis, Mo.; G. K. Stephens, D. W. Darrow, of Brinkley, Ark.; C. H. Williams and L. Minor, of Newport, Ark.; principal office, Newport, Ark.

Rocky Mt. and Pacific

CENTRAL ARIZONA.—D. M. Riordan, Gen. Man. Flagstaff, Ariz., is reported to have interested Chicago and Eastern capitalists in the construction of the pro-

jected railway to connect Durango, Colo., with Flagstaff, Phoenix, and Yuma, Ariz., and San Diego, Cal. W. A. Clarke, Jerome, Ariz., Pres. United Verde & Pacific Ry., is among those interested. A Yuma, Ariz., despatch says: The line is backed by and will use the bank of the Hudson Canal Co. from the junction of the Salt and Verde rivers to Yuma. The Arizona Central railway has 15 miles of track from Flagstaff south already laid, and 20 miles more graded. Ex-U. S. Senator John Martin, of Kansas, is President of the Hudson Canal Co., and Col. Wells Hendershot, of New York, is its attorney, and also attorney for the Arizona Central. The Utah Southern Railway will extend its line from Fresco, Utah, to Cedar City. The new lie crosses the Colorado River at Lee's Ferry, and the Atlantic & Pacific at Flagstaff, and the Southern Pacific at Yuma, where the Colorado River railway will connect with it from Cedar City, using the same road from Yuma to San Diego. At the latter place connections will be made with the San Diego belt line. Aline will also be built from the junction of the Salt and Verde rivers south via Tucson to Nogales, and also from Yuma south 65 miles to the Gulf of California, at the mouth of the Colorado. The Hudson Canal Co. is by far the most important irrigation project yet undertaken in Arizona. The legislature of Arizona has passed a law exempting any new railway built in the territory from taxation until July 5, 1905, which is equal to a subsidy of $3,000 per mile. The right of way has been secured for the new road from Flagstaff to Yuma. Engineers are already in the field locating the line south of Flagstaff. The road will open up the richest portions of Arizona.

IDAHO.—It is reported at Moscow, Idaho, that a railway is projected into the white-pine region of the Clearwater River. President Browne, of the Moscow National bank, is said to be interested.

RIO GRANDE WESTERN.—Officials of this company are quoted as saying that the projected extension from Salina to Marysvale, Utah, 44 miles, will be built this year. The line was surveyed some time ago. Resident Engr., E. J. Yard, Salt Lake City, Utah.

Foreign.

MEXICAN CENTRAL.—Press reports state that it has been definitely decided to extend this railway from Guadalajara westward to the Pacific coast. Lewis Kingman, Ch. Engr., is now making the final surveys. The terminus will probably be either at San Blas or Chametla. A new issue of bonds will be made to furnish the requisite capital.

MEXICO.—A despatch from Chihuahua, Mex., states that the McCormick Mower & Reaper Co., of Chicago, and Enrique Creel, a prominent banker of Chihuahua, have obtained a concession from the government for a railway from Chihuahua to the Ocampo mining district. The government gives a cash subsidy of $8,000 a mile. Two preliminary surveys of the road have been made, and it must be completed within two years.

MEXICO.—A press report from the city of Mexico states that the department of public works has approved the plans, and a concession has been granted to D. Dariano Barcena to construct a railway between San Luis Potosi and Guadalajara.

STREET AND ELECTRIC RAILWAYS.

BELFAST, ME.—The Waldo St. Ry. Co. proposes to build an electric railway between Stockton Springs and Camden. H. L. Shepherd, of Rockport, and William O'Brien, of Thomaston, are interested.——The Belfast St. Ry. Co. was recently incorporated to build an electric road from Belfast to Northport.——The construction of another electric railway between Stockton Springs and Camden is being considered by F. A. Colby and W. C. Perkins, of Berlin, N. H.; E. J. Morrison, of Belfast, and others.

BENNINGTON, VT.—Work on the Bennington & Woodford Electric Ry. was commenced last week under the direction of Wm. Green. The roadbed of the old Bennington & Glastenbury road will be used. The line will extend to Camp Comfort, four miles.

BRAINTREE, MASS.—The Braintree & Randolph St. Ry. Co. has been granted a franchise for its electric road between Randolph and South Braintree, work on which will probably begin at once.

BROCKTON, MASS.—The Brockton & North Easton St. Ry. Co. has been incorporated to build an electric railway; capital stock, $50,000; incorporators, John P. Morse, Warren A. Reed and H. B. Rogers, of Brockton, G. H. Campbell, of Lawrence, and Edwin S. Webster and Alfred A. Glasier, of Boston.

FALL RIVER, MASS.—The Fall River & Providence St. Ry. Co. has been incorporated to build a road between Fall River, Somerset and Swansea; capital stock, $250,000; incorporators, Frank S. Stevens, Swansea; Frank W. Brightman, Fall River; Robt. T. Davis and Wm. F. Thomas.

HULL, MASS.—Geo. F. McKay, of Boston, writes us that no progress has been made towards the construction of the Nantasket Electric St. Ry. since last noted in this journal. The postponement of the Hingham road, which was to connect with it, will probably delay any construction for the present season. Pres., Z. T. Harrington, of Hull.

MONTAGUE, MASS.—The Montague St. Ry. Co. has been incorporated with a capital stock of $40,000; Treas., C. E. Dresser, of Leominster; directors, H. L. Pierce, of Leominster; G. A. Andrews, of Montague; F. E. Allen, of Turners Falls; F. E. Law, of Greenfield.

WINCHESTER, MASS.—A company has been organized to build an electric railway between Stoneham, Winchester and Arlington, a distance of seven miles; capital stock, $100,000; A. B. Coffin, of Winchester; Onslow Gilmore, of Stoneham; G. E. Smith, of Boston; and Geo. S. Littlefield, of Winchester, are interested.

WORCESTER, MASS.—The Warren, Brookfield & Spencer St. Ry. Co. has been granted franchises in Spencer, Brookfield, West Brookfield and Warren, for its electric road from Spencer to West Warren, a distance of 15 miles. The company was lately incorporated with a capital stock of $200,000 by M. H. Potter, E. E. Dickermann, and F. W. Boulton.

BROOKLYN, N. Y.—The Union St. Ry. Co. has again petitioned for a franchise for an electric railway on Hamilton Ave., Union and Ninth Sts. The company offers to pay 3% of its gross receipts and $30,000 in cash for the franchise. Pres., Reuben Leland; Secy., Edward M. Grout.

NEW YORK, N. Y.—The Metropolitan Traction Co. is considering the question of extending its cable road to connect with the North River ferries near 23d St., and to parallel its Broadway road from Union Square to the Cortlandt and Liberty St. ferries.

SYRACUSE, N. Y.—The Syracuse & Oneida Lake Electric Ry. Co. has been incorporated to build a road from Cicero to Salina, a distance of 12 miles; capital stock, $300,000; directors, Hiram McGonegal, of New York; W. S. Wales, Thos. W. Meacham, James N. McCormack and Wm. E. Wheaton, of Syracuse.

FRANKLIN, N. J.—It is reported that the Passaic & Newark Electric Ry. Co. will build a power house on Passaic Av.

NEW BRUNSWICK, N. J.—The Brunswick Traction Co. has been incorporated with a capital stock of $500,000, of which $100,000 is paid in; incorporators, Gottfried Krueger, John Radel and Edward H. Radel, of Newark.

PITTSBURG, PA.—Press reports state that the Pittsburg, Neville Island & Coraopolis Ry. has been sold to J. D. Callery, Thomas M. Bigelow, J. C. Reilly, W. J. Burns, A. L. Schultz and Thomas R. Pittock, representing the Pittsburg & West End Traction Co. and the Second Ave. Traction Co., for $100,000. The road is 14 miles long, operating from Chartiers to Coraopolis, over Neville Island. It is the intention to extend the line to New Brighton by way of a bridge at Sewickley.

TOWANDA, PA.—It is reported that the right of way is being secured for an electric railway between this place and Canton. Robt. Drake, of the Lehigh Valley R. R. Co., is interested.

CHARLESTON, S. C.—Hoefgen and Edgar Moxlam, representing a Brooklyn syndicate, are said to have purchased the Charleston City Ry. and Enterprise R. R. It is proposed to equip both roads with electricity, according to reports.

PHENIX CITY, ALA.—The Phenix City Ry. Co. has been organized to build a railway three miles in length, work on which will begin very soon. Capital stock, $30,000; Pres., J. F. Flournoy; Vice-Pres., J. Wainwright; Treas., W. S. Drake; Secy., C. B. Grimes; Supt., J. H. Henderson.

CHAGRIN FALLS, O.—Albert W. Buel and Frank Ford have completed surveys for an electric railway between Cleveland and this place, a distance of 13½ miles, and estimated to cost $135,000. Albert Mitchell, of Newburg, and C. B. Thompson, of Cleveland, are interested.

GREENWOOD, IND.—It is reported that plans have been prepared for the Indianapolis, Greenwood & Franklin Electric Ry., work on which will commence at once. Grafton Johnson, J. R. Langsdale and Henry Smith are interested.

LA PORTE, IND.—Alvin G. Tillotson, and Henry B. Tuthill, of Michigan City, have been granted a 25-year franchise for an electric railway to enter this city from Michigan City, estimated to cost $100,000.

PORT HURON, MICH.—A company has been organized to build an electric railway to Lexington. Pres., Edgar Brennan; F. F. Rogers, Cy. Engr.

SAGINAW, MICH.—It is reported that the Saginaw & Bay City Rapid Transit Co. is about to begin the construction of its electric road. Pres., F. M. Afterhold, of Akron, O.; Gen. Man., George Silsby; Ch. Engr., W. D. Chapman.

CHICAGO, ILL.—The Chicago, Lamont & Joliet Electric R. R. Co. has been incorporated with a capital stock of $300,000; incorporators, M. H. Neilbronn, S. T. Hart, E. D. Hopkins and G. Lawrence Taylor.

BARABOO, WIS.—F. A. Philbrick, of Chicago, has petitioned for a franchise for an electric road to Devil's Lake.

MILWAUKEE, WIS.—The Milwaukee & Waukesha Ry. Co. has been incorporated to equip the Milwaukee & Wauwatosa motor road with electricity; capital stock, $1,000,000, with $286,000 paid in; incorporators, Max Rosenthal, James Petley, A. B. Myers and Joel W. Bingham, of Milwaukee, and John J. Constantine and Andrew Snyder, of Waukesha.

OSHKOSH, WIS.—It is reported that the Oshkosh St. Ry. Co. is preparing to equip its road with electricity.

ST. LOUIS, MO.—The Howard Construction Co. has been incorporated to build an electric railway from the western part of the city through Kirkwood to Meramec Highlands, work to begin by July 1; capital stock, $10,000, with $5,000 paid in; incorporators, Thomas Howard, John A. Holmes, J. C. Richardson, John J. Broderick, N. C. Chapman and Chas. B. Greeley.

SAN ANTONIO, TEX.—The Alamo Heights R. R. Co. has been incorporated to build a street railway; capital stock, $62,000; incorporators, Chas. W. Ogden, C. L. Harwood, and Sidney K. Buchanan, of San Antonio; Edwin Packard and Spencer A. Jennings, of Brooklyn.

NAPA, CAL.—It is reported that L. Crothwell, of San Francisco, has petitioned for a franchise for an electric road from this place to Calistoga, a distance of 27 miles; and also to Napa Soda Springs, estimated to cost $400,000.

ELECTRIC LIGHT AND POWER.

HINSDALE, N. H.—The town has voted to issue $10,000 in bonds for an electric light plant, according to reports.

BARTON, VT.—The village has voted to issue $10,000 in bonds and to borrow $9,000 to put in an electric light plant, the power for which will probably be obtained from Plunkett Falls, in Charleston, 14 miles distant.

OHICOPEE, MASS.—It is reported that the question of constructing an electric light plant is being considered. J. F. Perry, Supt. Electric Light Co., of Braintree, is interested.

BROOKLYN, N. Y.—Bids are asked until June 4 for furnishing electric lights for the streets and public buildings for 1895. A. T. White, Comr. Cy. Wks.

GLOVERSVILLE, N. Y.—The Gloversville Electric Co. has voted to erect an additional building to its plant, and put in a new generator and other machinery. Paul T. Brady, of Syracuse, and H. N. Hinman, of Cooperstown, are interested.

NEWARK, N. J.—Bids are asked by the Newark Electric Light & Power Co. for a good second-hand high-speed compound 300 to 400-HP. engine, with generators, as stated in our advertising columns.

RAHWAY, N. J.—The committee has been directed to advertise for bids for lighting the streets with electricity, etc., for five years. W. E. Clark, Cy. Surv.

DARBY, PA.—Bids are asked until June 3 for lighting the streets with electricity. Amos Anderson, Chn. Com.

SCOTLAND NECK, N. C.—Bids are asked until June 15 for putting in an electric light plant of one 1,500-light engine, about 1,000 incandescent lights, etc., according to reports. J. T. Graham, Town Clk.

PULASKI, TENN.—It is reported that $8,000 in electric light bonds have been sold.

LEXINGTON, KY.—Bids are asked until June 19 for lighting the streets with electricity or gas for five or ten years, according to reports. K. T. Duncan, Mayor.

COLUMBUS, O.—The Columbus Electric Light & Power Co. has petitioned for a franchise. The company has a capital stock of $25,000. Pres., Eugene Lane; Secy., R. J. M. Danley.

GREENVILLE, O.—Bids are asked until June 8 for lighting the streets with electricity. H. J. Brenneman, Cy. Clk.

NORWOOD, O.—The citizens have voted to issue $30,000 in bonds for an electric light plant.

LANSING MICH.—The university committee of the senate is considering a bill appropriating $45,000 for an electric light plant and an addition to the law library building of the university.

AITKIN, MINN.—It is reported that $10,000 of 5% bonds for an electric light plant are to be sold. F. E. Seavey, Cy. Recdr.

LAKE CITY, MINN.—It is reported that Burtis & Howard, of Minneapolis, have been awarded the contract for a 650-incandescent light dynamo and a 60-arc light dynamo. A contract was also awarded for a Ball & Wood engine. The plant is to be completed in 60 days, and will cost $8,374.

MANKATO, MINN.—M. B. Haynes, Cy. Engr., writes us that an election is to be held July 9 to vote on the question of issuing $10,000 in bonds for an electric light plant at the water-works pumping station. Calvin Smith, Cy. Clk.

MOULTON, IA.—Arrangements are being made to put in an electric light plant, according to reports.

FERGUSON, MO.—The town has voted on the question of constructing an electric light plant, estimated to cost $10,000.

SPRINGFIELD, MO.—An election will be held June 8 to vote on the question of issuing $60,000 in bonds for constructing an electric light plant. T. L. Dunlap is interested.

LOS ANGELES, CAL.—Bids are asked until June 20 for constructing an electric light plant for the National Home, to cost about $10,000. Treas., Maj. F. K. Upham; Col. J. G. Rowland, Governor.

RIVERSIDE, CAL.—It is reported that the question of issuing $40,000 in bonds for an electric light plant is about to be voted upon.

SAN FRANCISCO, CAL.—A company has been organized to put in a new electric light plant. P. B. Cornwall, formerly president of the California Electric Light Co., is interested.

SANTA ANA, CAL.—The question of issuing $18,000 in bonds for an electric light plant is being considered.

NEW COMPANIES.—The Parkersburg Light & Power Co., Parkersburg, W. Va.; $500,000; C. C. Martin, W. W. Chancellor, W. W. Van Winkle, John V. Rathbone.

Geauga County Telephone & Electric Co., Huntsburg Center, O.; $2,000; Geo. W. Pease, L. T. Wilmot, O. M. Barnes, S. A. Rowley.

Fort Madison Water Co., Fort Madison, Ia.; $250,000, with $500 paid in; to supply electricity, gas, water, etc.; Pres., G. F. Noyes, of Portland, Me.; Treas., H. M. Verrill, of Portland, Me.

Bissell, Dodge & Erner Co., of Toledo, O.; $25,000; to manufacture electrical machinery and erect electric and mechanical plants, etc.; Frederick Bissell, Frederick H. Dodge, John A. Erner.

BRIDGES.

HINESBURG, VT.—A special town meeting will be held June 1 to vote on the building of an iron bridge near the Lewis Creek creamery.

WINOOSKI, VT.—It is stated that an iron bridge will be built at McCrae Cove, near where the old bridge was recently carried away by high water.

FALL RIVER, MASS.—Henry M. Plummer and others have been granted permission to build a bridge 60 ft. in width across Little River in Dartmouth.

BOSTON, MASS.—Plans have been prepared for eliminating the grade crossings of the Providence division of the New York, New Haven & Rartford R. R. in this city, as noted under Railways, the work requiring a large number of bridges.

HARTFORD, CONN.—The East Hartford wooden bridge across the Connecticut River was burned May 17. The Berlin Iron Bridge Co. has constructed a temporary bridge at a cost of $18,000.

AMSTERDAM, N. Y.—It is reported that the New York Central & Hudson River R. R. Co. has asked for bids for the masonry work for the Bridge St. overhead crossing in this city.

BUFFALO, N. Y.—Bids are asked until June 21 for the construction of the superstructure for a lift bridge on Michigan St., over the Buffalo River. R. G. Parsons, Secy. Dept. Pub. Wks.

COHOES, N. Y.—The Cohoes City Ry. Co. has awarded the contract for constructing a steel bridge over the Erie Canal at Columbia St., to the Boston Bridge Wks.

CORINTH, N. Y.—Press report state that the Saratoga county board of supervisors has adopted resolutions authorizing this town to bond itself for one-third of $14,600 for the erection of a new iron free highway bridge over the Hudson River, connecting the towns of Corinth and Luzerne, and levying one-sixth of the amount on Saratoga county. The Warren county supervisors had previously taken similar action.

FLUSHING, N. Y.—The citizens have petitioned for the improvement of the drawbridge of the Long Island R. R. Co. over Flushing Creek at Bridge St., in response to which Col. Henry M. Roberts, U. S. Engrs., has made an inspection of the draw.

LONG ISLAND CITY, N. Y.—John J. McLaughlin has prepared plans, which have been approved by the secretary of war, for a new lift bridge over Newtown Creek, from Vernon Ave. to Manhattan Ave.

NEW YORK, N. Y.—A bill has been prepared authorizing the construction of a new bridge across the Mott Haven Canal at 138th st. J. H. Hildreth, of the North Side Board of Trade, is interested.

JERSEY CITY, N. J.—Plans have been adopted for a new bridge at Montgomery St., over Cornelison Ave., which was partly destroyed by the breaking through of a steam road roller May 12. The bridge is to be constructed jointly by the city and the Consolidated Traction Co.

JERSEY CITY, N. J.—Bids are asked until June 17 for building a steel viaduct in Mercer St., the work to include 350 piles, 7,800 ft. B. M. yellow pine, 750 lin. ft. of viaduct, 700 lbs. bolts and spikes, etc. John C. Kaiser, Chn. Com.

OCEAN PORT, N. J.—The citizens have petitioned Lieut. Col. Geo. L. Gillespie, U. S. Engrs., New York, to take steps to widen the draw of the railway bridge across the Shrewsbury River at this place. The improvement was once recommended, but was then disapproved by the Secretary of War.

BALFOUR, PA.—S. B. Kissel, H. S. Mohler and Daniel Shopp, viewers, have recommended that a new bridge be built over the Conodoquinet River at this place.

CLARION, PA.—The commissioners have received the following bids for building a bridge across the Clarion River at the mouth of Piney Creek; the masonry work is noted under Contract Prices:

The Iron Substructure Co.	$8,869
Massillon Bridge Co.	8,649
King Bridge Co.	8,780
Nelson & Buchanan (awarded contract)	8,360
Penn Bridge Co.	8,790
Youngstown Bridge Co.	8,960
Toledo Bridge Co.	8,795
P. H. Melvin	7,976
Champion Bridge Co.	8,850
Wrought Iron Bridge Co.	8,420
Canton Bridge Co.	8,970
Dean & Westbrook	8,995
Groton Bridge Co.	8,900
Variety Iron Works	8,800
Bracket Bridge Co.	8,820
New Columbus Bridge Co.	8,890
Horseheads Bridge Co.	8,990
Berlin Iron Bridge Co.	8,864

JOHNSTOWN, PA.—The council has passed an ordinance authorizing the city engineer to prepare plans for a bridge over the Conemaugh River from Maple Ave. to Franglin borough, and to confer with the Cambria Iron Co. relative to having it build the abutments.

SOMERSET, PA.—It is proposed to construct a bridge over the Youghiogheny River at Confluence. A. J. Colborn, J. H. Zimmerman and J. H. Bird are viewers.

WAYNESBURG, PA.—Bids are asked by the county commissioners until June 1 for building abutments for two bridges.

BALTIMORE, MD.—Plans have been prepared for a bridge over the Baltimore & Ohio R. R. at Barre st. Engr., Frederick T. Smith.

COLUMBUS, O.—The construction of a bridge to cost $10,000 to $12,000 over Alum Creek is being considered by the Clinton & Blendon Plank Road Co., now in the hands of a receiver.

LOGANSPORT, IND.—It is reported that bids will be asked at once by the county commissioners for a new bridge over the Eel River at Market st. Engr., W. S. Lincoln.

RICHMOND, IND.—The city commissioners are taking steps for a new bridge at Main St.

DES MOINES, IA.—The committee of the board of supervisors has recommended the construction of a bridge in Madison township, estimated to cost $15,000.

SIOUX CITY, IA.—It is reported that the Credit Commutation Co. has voted to build a bridge, estimated to cost $1,000,000, over the Missouri River, between this city and Covington, Neb., to connect the Short Line Ry with the Sioux City stock yards.

GLENDIVE, MONT.—The following bids have been received for the construction of a pivot drawbridge over the Yellowstone River: Gillette-Herzog Co., $39,000 and $39,500; Wisconsin Bridge & Iron Co., $40,500; Iron Substructure Co., $39,000; S. M. Hewett & Co., $39,000; C. E. A. Campbell, $39,700; King Bridge Co., $39,000 (awarded contract) and $39,750; Milwaukee Bridge & Iron Co., $37,627; Rinker & Hoff, $38,600; Youngstown Bridge Co., $39,000, $37,920 and $36,657.

CAPE GIRARDEAU, MO.—Bids are asked until June 21 for constructing one iron and one wooden bridge, according to reports. Address L. M. Bean, of Gordonville, Mo.

JEFFERSON CITY, MO.—The Jefferson City Bridge & Transit Co. is reported to have secured sufficient subscriptions and to have awarded a contract to A. J. Tullock, of the Missouri Valley Bridge & Iron Wks., of Leavenworth, Kan., for the construction of a steel highway bridge across the Missouri River at this place, at about $200,000. Consult. Engr., A. J. Waddell.

GALVESTON, TEX.—Bids are asked until June 20 for constructing an iron bridge over Clear Creek, according to reports. Address Judge Hanscom, Galveston, Tex.

HEMPSTEAD, TEX.—Edmund Montgomery is reported about to petition the commissioners' court for a bridge over the Brazos River on the Hempstead-Bellville road.

LOMETA, TEX.—It is reported that the commissioners' court has voted to build a bridge over the Colorado River at Red Bluff.

VICTORIA, TEX.—Press reports state that the commissioners' court has decided to build three iron bridges in this county, as follows: One over the Coletto Creek on the Refugio road, at what is known as Warden's crossing; one over the Garcitas Creek on the Edna road, and one over the Guadalupe River near Nursery.

HAMILTON, ONT.—The Toronto, Hamilton & Buffalo Ry. Co. has been granted permission to build a 40-ft. span steel bridge over Aberdeen Ave.

WINDSOR, ONT.—It is reported that the railway committee of the Canadian house of commons has acted favorably on a bill authorizing the Canada & Michigan Tunnel & Bridge Co., to build a 1,000-ft. span drawbridge over the Detroit River.

MONTREAL, QUE.—Press reports state that the South Shore Suburban Ry. Co. has petitioned for permission to build a bridge over the St. Lawrence River, from Longnewel or St. Lambert to this city. The capital stock of the company is placed at $1,000,000.

BUILDINGS.

GREENWICH, CONN.—It is reported that V. G. Hedden & Son have been awarded the contract for grading the grounds and building a new club house on the site of the Americus Club House, for E. C. Benedict, at about $1,000,000.

ALBANY, N. Y.—The governor has signed the bill authorizing the completion of the capitol by contract. It is estimated that $2,638,442 will be needed for the completion. The legislature appropriated $400,000 to be used in constructing such portions as the commission may determine to have done by day labor. Isaac G. Perry, Capitol Comr.

BROOKLYN, N. Y.—The Brooklyn Warehouse & Dry Dock Co. has been incorporated, with a capital stock of $300,000; incorporators, Edgar S. Hicks, Seth L. Keeney and David H. Valentine, of Brooklyn, and Ransom Lamb, of New York.

BROOKLYN, N. Y.—Bids are asked until June 4 for constructing a school building at Monitor St. and Driggs Ave., and making additions to the school building on Union St. John McNamee, Chn. Com.——Bids are asked until June 4 for heating and ventilating two school buildings. J. R. Thompson, Chn. Com. Dept. Pub. Instruction.

NEW YORK, N. Y.—Plans are asked by the New York Athletic Club, Sixth Ave. and 59th St., until June 3 (postponement from May 25) for a new club house, estimated to cost $850,000. Secy., John C. Gulick.——The Union Club is considering the question of erecting a new club house, estimated to cost about $1,000,000, at Fifth Ave. and 54th St., on the site of St. Luke's Hospital. Pres., Clarence A. Seward.——The Board of Trustees of the Metropolitan Museum of Art is considering the erection of a new building, estimated to cost $1,000,000. Richard M. Hunt is a trustee.——Plans have been filed by Josiah S. Lindsay, 357 Fourth Ave., for an eight-story brick warehouse at 103 Fifth Ave., to cost $120,000.——The New York University has received a gift of $250,000 for a central building at University Heights.——Plans have been completed for a four-story building at 115 Chambers St. for the Irving Saving Institution, 96 Warren St., work on which, it is reported, will begin in June. Secy., G. B. Latimer.

JERSEY CITY, N. J.—Bids are asked until June 3 for constructing a school building at Wayne and Colgate Sts. John C. Kaiser, Chn. Com.

TRENTON, N. J.—Press reports state as follows: The commission appointed to supervise the erection of an addition to the state prison has decided upon the plans from among those submitted by the contestants for the prizes offered. The prize of $300 for the best plan was awarded to Thomas Cresse, of Newark, and the second prize, of $200, to the Pauly Jail Mfg. Co. The other contestants were Lewis H. Brown, of Jersey City, and Proudfoot & Bird, of Jersey City. The work of building the new wing and hospital will begin at once.

ALLEGHENY, PA.—Bids are asked until June 3 for the erection of an engine house on Madison Ave. Arch., Joseph Stillburg, 20 Fifth Ave., Pittsburg; John R. Murphy, Dir. Dept. Pub. Safety.

PHILADELPHIA, PA.—Bids are asked until June 12 for the metal work for the new Port Penn light station, as stated in our advertising columns. Maj. Chas. W. Raymond, U. S. Lighthouse Engr.——Bids are asked until June 3 for the erection of a police, patrol and fire station on 15th St. A. M. Beltler, Dir. Dept. Pub. Safety.

PITTSBURG, PA.—The following bids have been received by the director for a department of public safety building: Wm. Kerr's Sons, $195,179; Murphy & Hamilton, $202,000; Charles A. Balph, $189,300; William Miller & Sons, $199,325; Kerr & Fox, $193,416; Fred Benty, $216,000; George A. Cochran, $209,573; Henry Shenk, $215,483.

WASHINGTON, D. C.—Bids are asked until June 8 for constructing the approaches to the post office building at Galesburg, Ill. Wm. Martin Aiken, Supervising Arch.

NEW ORLEANS, LA.—Bids are asked until June 12 for furnishing material and labor of all kinds for the completion and delivery of the metal work for the Brazos River light station, as stated in our advertising columns. The bids recently received for this work were published in our issue of May 16. Maj. Jas. B. Quinn, U. S. Lighthouse Engr.

PULASKI, TENN.—Bids are asked until June 15 for constructing a portable iron cage 32x7½ ft. for the workhouse. J. P. Butler, Com.

CLEVELAND, O.—Bids are asked until June 19 for rebuilding the Hicks school building. H. L. Sargent, School Dir., Bd. of Education.

DOVER, O.—It is reported that contracts will be awarded at once for the erection at Mount Gilead of a foundry building 120 × 80 ft., enameling building 100 × 30 ft., general manufacturing building 100 × 30 ft., and a machine shop 20 × 30 ft.

SPRINGFIELD, ILL.—Plans are being prepared for a new three-story sandstone station for the Illinois Central R. R. Co., estimated to cost $10,000 to $25,000, for this place, according to reports.

LE MARS, IA.—It is reported that Burkhead & Reese, of Sioux City, have prepared plans for a new three-story city hall.

ST. LOUIS, MO.—Plans have been completed for the erection of a new two-story brick factory building, 240 × 200 ft., for the Parker-Russell Mining & Mfg. Co., according to reports.——It is reported that Henry I. Cobb, of Chicago, is preparing plans for a 17-story bank, store and office building at Eighth and Olive Sts. for the Olive Bldg. Association, estimated to cost $700,000.

ST. JOSEPH, MO.—Plans are to be prepared for reconstructing the building of the St. Joseph Pump Factory, which was destroyed by fire May 13, at a loss of about $50,000. Secy. and Man., E. A. King.

DENTON, TEX.—Plans are asked until June 24 for a $100,000 court house. C. L. M. Crowdier, County Clk.

PARIS, TEX.—Bids are asked until June 20 for the erection of a court house for Lamar county. Arch., A. O. Watson, Austin; J. C. Hunt, County Judge.

WATER-WORKS.

BANGOR, ME.—The water board has recommended that 100 meters be purchased.——M. N. Tidd, Engr., Boston, has recommended that a new 10,000,000-gallon pumping engine, or two of half this capacity each, and a 40 × 100-ft. stand-pipe be purchased, and that other improvements be made.

MACHIAS, ME.—At a special town meeting last week it was voted to contract with the Machias Water Co. for 30 hydrants, at $1,500 a year.

MECHANIC FALLS, ME.—The town has voted to grant a franchise to W. H. Hayden, of Bath, and to contract for 35 hydrants, at $1,600 a year. The water will be pumped from driven wells.

RUMFORD FALLS, ME.—Bids are asked by the Rumford Falls Light & Water Co. until June 8 for trenching and back-filling for proposed extensions.

CAMBRIDGE, MASS.—The contract for excavating soil and material at Hobbs Brook storage basin has been awarded to J. H. Leavitt, of Boston, at $20,693 and $26,617 for the two sections.

HAVERHILL, MASS.—We are informed that contracts have been awarded to Donato Cuozzo, 386 Broome St., New York, for building stone masonry dam, at $13,142, and for stripping soil and loam, about 98,000 cu. yds., at $28,018.

LEXINGTON, MASS.—The town has voted to hold a special meeting in June to vote directly upon the question of purchasing the works.

ALBANY, N. Y.—Contracts for laying water mains will probably be awarded to M. J. Daly, at $8,485 and $4,361, he being the lowest bidder for the two contracts.

JAMAICA, N. Y.—The Montauk Water Co. has been incorporated to construct works in Kings, Queens and Suffolk counties; capital stock, $500,000; directors, Wm. F. Brown, H. M. Conover and A. N. Hegre, of Brooklyn; J. H. Jones, of New York, and others.

NAPLES, N. Y.—W. H. Toby, W. L. Pottle and C. S. Lincoln have been appointed a committee to investigate the question of works, get estimates, etc.

NEW YORK, N. Y.—Bids are asked by the department of public works until June 11 for laying water mains in 24 streets.——It is again stated that bids will soon be asked for the construction of the new Jerome Park reservoir.

NEW ROCHELLE, N. Y.—The New Rochelle Water Co. has contracted to supply water to Tuckahoe and Bronxville. The work will require about 10 miles of pipe, a water tower and about 50 hydrants, for which the company will receive $30 each a year.

PERRY, N. Y.—The village trustees are reported to have decided to submit the question of works to a vote of the taxpayers. It is stated that if the proposition is voted down a private company will ask for a franchise.

PHILMONT, N. Y.—Geo. W. Vedder, Village Clk., writes us that an engineer has been in the village a few days looking over the ground, and that a meeting of the residents will probably soon be held to decide upon the question of construction.

ROXBURY, N. Y.—The Bloomville Water Co. has been incorporated, with a capital stock of $10,000, by F. M. Andrus, W. M. Banker, B. B. Robinson, of Roxbury, and others.

SCHENECTADY, N. Y.—We are informed that the following bids were received May 23: For pumping engines and boilers—E. P. Allis Co., $63,000 and $63,000; Groshon High-Duty Pumping Engine Co., $74,000; Deane Steam Pump Co., $52,000, $52,400, $52,970, and $52,450; Snow Steam Pump Works, $54,980 and $72,350; Holly Mfg. Co., $64,950, $62,100, $59,800, and $56,975.

	Intake.	Force Main.
John Fox, New York		$54,000
L. J. Richardson, Oswego		55,660
John Twomey, Schenectady	$25,370	55,419
P. H. Harrison & Sons, Newark, N. J.		48,529
John McDermott, Schenectady		48,757
Flood & Sheriff, Sandy Hill		52,389
John Doyle, Albany		56,000
Joseph H. Clements, Schenectady	29,994	55,634
A. F. Nicus, Elkhart, Ind.	27,695	49,944
M. B. Birdseye, Fayetteville		47,762
Troy Public Works Co., Troy	30,000	50,000
Sandford & Stillman Co., Jersey City	37,500	50,500

SYRACUSE, N. Y.—The governor has signed the bill authorizing this city to issue $500,000 in bonds for a water supply.

UNIONVILLE, N. Y.—The residents of this village have voted to contract with the Unionville Water Co. for water for fire purposes at $320 a year.

WARSAW, N. Y.—A special election will be held June 3 to vote on the question of municipal ownership of works.

WARSAW, N. Y.—Bids are asked by the Warsaw Water-Works Co., until June 3, for trenching and laying about two miles of extensions of the mains.

DECKERTOWN, N. J.—Bids are asked until July 1 for the construction of works, as stated in our advertising columns. J. B. Whittle, Borough Clk.

HIGHTSTOWN, N. J.—Isaac S. Cassin & Son, of Philadelphia, have been engaged to prepare plans and superintend the construction of works. A. S. Voorhees, C. J. Hazzard and E. M. Norris have been appointed commissioners.

CARNEGIE, PA.—The bids for 100 fire hydrants, noted last week, were as follows: Monongahela Water Co., $14 per hydrant per year; St. Clair Water Co., $18.

CLAYSVILLE, PA.—The contract for works has been awarded to L. G. Hallock, of Wheeling, W. Va., who has sublet the contract for a 25 × 30-ft. steel reservoir to Cox & Co., of Wheeling. The water supply will be pumped by windmills from wells.

DUQUESNE, PA.—S. A. Taylor, Wilkinsburg, Pa., has prepared plans for works at this place, and a special election will soon be held to vote on an issue of bonds for the construction. J. W. Crawford, Chn. Com.

MEADVILLE, PA.—The Meadville Water Co. has offered to sell its plant to the city for $105,000. The offer before the council had contracted for new works

was $138,000, and the council at that time offered to pay $78,000.

WILMINGTON, DEL.—It is reported that the pumping station will be improved at a cost of $15,000.

LONACONING, MD.—The "Star" of this place states that Malcolm Sinclair, who has the franchise for work, is considering bids for the construction.

CEREDO, W. VA.—It is stated that $6,000 has been secured toward the construction of a $10,000 plant by a private company.

DARIEN, GA.—It is reported that a franchise will be granted to a company that will take immediate steps to construct works and an electric light plant.

CULLMAN, ALA.—Bids are asked until July 1 for the construction of works, the cost not to exceed $15,000. The contractor is to furnish plans and specifications and the city will pay $100 for the specifications adopted if the party submitting them does not receive the contract. J. H. Karter, Chn. Com.

DEMOPOLIS, ALA.—The council has appointed a committee to investigate the question of works.

MARION, ALA.—This town is reported about to sell $25,000 in 6% 30-year water bonds.

GREENVILLE, MISS.—Bids are asked until July 2 for a 25-year franchise for works. J. M. Lee, Cy. Clk.

COVINGTON, KY.—The commissioners have contracted to supply Central Covington with water at $1.40 per 10,000 gallons per day. Central Covington is to lay the mains, etc.

BUCYRUS, O.—It is reported that work will be commenced in a few days on a 60,000,000-gallon reservoir.

CLEVELAND, O.—The director of public works has been authorized to prepare plans and take the necessary steps for the extension of the present intake tunnel farther into the lake and also for an additional tunnel in the eastern part of the city.

COLUMBIANA, O.—This city has sold $38,000 in bonds, and it is stated that the contract for constructing works and an electric light plant will be awarded at once. The proposed supply from artesian wells has been approved by the state board of health.

BRAZIL, IND.—John Macdonald, Cy. Clk., writes us that the contract for improving and extending the works has been awarded to the Howe Pump & Engine Co., of Indianapolis, who will cash $15,000 in school bonds and $25,000 in water extension bonds for the city. The work will be commenced at once.

EVANSVILLE, IND.—Local papers state that 82 cases of typhoid fever have been reported within a week, and that steps are being taken to secure a purer water supply.

GARRETT, IND.—At the election May 20 the citizens voted to construct works, which will require from four to six miles of mains.

MICHIGAN CITY, IND.—G. S. Van Deusen, Mayor, writes us that nothing has yet been done about the removal of the works, and it has not been decided that anything will be done this year.

ADRIAN, MICH.—The council is negotiating with the O. H. Jewell Filter Co., of Chicago, for a filter, which, it is stated, is being put in on trial.

BATTLE CREEK, MICH.—A petition is being circulated asking for important extensions, according to reports.

HUBBARDSTON, MICH.—Residents of this village are reported as agitating the question of works.

MILFORD, MICH.—M. Walker, of Fenton, Mich., is reported to have prepared plans for works at this place, estimated to cost about $14,000.

THOMPSONVILLE, MICH.—It is stated that $3,000 in bonds will be sold for works.

CHICAGO, ILL.—Bids are asked until June 6 for furnishing material and laying mains in 14 streets. W. D. Kent, Comr. Pub. Wks.

MOUNT CARROLL, ILL.—E. T. E. Becker, Chn. Com., writes us that the contract for an air lift pump has been awarded to the Knowles Steam Pump Works for a Bacon air lift pump, to deliver 300 gallons of water per minute.

MOUNT PULASKI, ILL.—Z. K. Wood, Chn. Com., writes us that the contracts for works have been awarded as follows: Campbell, Dennis & Co., Joliet, Ill.—Pump and boiler, $2,650; pump station, $1,650; tower and tank, $2,950. Addyston Pipe & Steel Co., Cincinnati—403 tons pipe, $7,616; 23,339 lbs. castings, $526. Rensselaer Mfg. Co., Troy, N. Y.—40 valve boxes and 40 gate valves, $480. Michigan Brass & Iron Co., Detroit, Mich.—24 hydrants, $552. Chas. Stookey, Belleville, Ill.—Pipe laying, $3,003. Total, $19,427.

ODELL, ILL.—A press report states that this place will spend $8,000 for works.

PITTSFIELD, ILL.—This city is prospecting for a new water supply, the present supply, from an artesian well, being inadequate. E. J. Chamberlain, Cy. Engr.

CAMP DOUGLAS, WIS.—There is talk of constructing works, at an estimated cost of about $4,000.

DEERFIELD, WIS.—This village is reported to have voted in favor of works, and to have appointed a committee to visit other places and to investigate the question.

FORT ATCHISON, WIS.—W. O. Hoffman, Cy. Clk., writes us that surveys and plans will soon be made for works in order that an accurate estimate may be obtained, but that nothing definite has yet been decided upon. The supply will probably be from an artesian well; population, 3,000.

INDEPENDENCE, WIS.—Bids are asked until June 19 for constructing works, which will include about 4,000 ft. of 8 to 4-in. main. Jacob Jackson, Village Clk.

SHEBOYGAN, WIS.—The Plymouth Water, Light & Power Co. has been incorporated, with a capital stock of $60,000 by H. G. Malone, H. G. Dow, and S. J. Foot.

DELMAR, IA.—The residents of this place are reported as agitating the question of works.

LIVERMORE, IA.—It is reported that a 6-in. artesian well will be sunk at once to secure a supply for the proposed works, for which bonds were recently voted.

LOGAN, IA.—It is stated that an election will probably be held at an early date to vote on the question of works.

MONTEZUMA, IA.—Bids are being received, according to reports, for the construction of works, for which plans were recently prepared.

MASON CITY, IA.—The council is reported to have voted to make extensions for which 160 tons of pipe will be purchased.

AMBOY, MINN.—At a special election last week the citizens voted to issue $4,000 in bonds for works, which will be constructed as soon as possible.

EVELETH, MINN.—Bids are asked until June 1 for the purchase of $3,000 in bonds, recently voted for works. Charles Erickson, Recdr.

HIBBING, MINN.—Bids are asked until June 11 for the purchase of $11,400 in water and light bonds. J. B. Connors, Recdr.

ST. CLAIR, MINN.—It is reported that this village is contemplating the construction of works to cost $4,000.

SANDSTONE, MINN.—At the annual meeting of the Minnesota Sandstone Co. at Minneapolis, the directors voted to appropriate $10,000 for water-works and $25,000 for street improvements at this place. Pres. Geo. B. Beston; Secy., Clarkson Lindley.

STEWARTVILLE, MINN.—D. W. Morse, Village Recdr., writes us that bids will probably be opened in about 30 days for works to cost $5,000 to $6,000.

SALEM, S. DAK.—The city is reported as about to make extensions and other improvements of the works.

BROOKFIELD, MO.—It is reported that $10,000 in bonds will be issued for works.

MERAMEC HIGHLANDS, MO.—The Meramec Highlands Co. has purchased the franchise of the Sunset Hill Water, Light & Power Co. and it is stated will construct works to supply Kirkwood, Woodlawn, Oakland, Spring Park, Glendale, Webster Groves, Selma, Clayton, and other towns in St. Louis county between Meramec Highlands and the city of St. Louis. Pres., Marcus Bernheimer.

EL PASO, TEX.—Bids will be received until June 21 for the purchase of water bonds. We are informed that as soon as these are sold the council intends contract for new works for which John B. Hawley, of Fort Worth, recently prepared plans.

HILLSBORO, TEX.—A press report states that the city will proceed at once to secure plans and construct works.

JACKSONVILLE, TEX.—The council is discussing the construction of works.

LOMETA, TEX.—J. T. Brown is reported as about to construct works at this place.

MARLIN, TEX.—It is reported that works will probably be put in at an early date.

PORT ELGIN, ONT.—Bids are asked for the erection of a windmill pump with a 60-ft. steel tower. W. Burgess, Clk.

IRRIGATION.

BOISE CITY, IDAHO.—Press reports state that an English expert has been examining the Perrault ditch, which runs through this city, has made a favorable report to his company, and the deal for the purchase of the waterway will be closed up at once. The consideration is $50,000, but the company will extend the ditch down the valley and make other developments to the amount of $250,000. A favorable report was made after an arrangement had been made by the state board whereby 60,000 acres of land will be reclaimed under the Carey Act.

NEW COMPANIES.—Minnescah Irrigation Co., Pratt, Kan.; $25,000; J. S. Barnes, H. T. Arble, Pratt; T. H. Bircher, Cairo, Kan.

Puente Land & Water Co., Puente, Cal.; $100,000, with $20,000 paid in; to construct ditches, reservoirs, etc., for irrigation; J. W. Hudson, Thomas Rowland, Wm. R. Rowland, B. F. Rowland, Puente.

SEWERAGE.

BOSTON, MASS.—Bids are asked until June 8 for building the Alewife Brook pumping station for the metropolitan sewerage system, in Somerville. Arch., Ernest N. Boyden, 35 Congress St.; Wm. M. Brown, Jr., Acting Ch. Engr.

HOLYOKE, MASS.—The question of constructing about 206 ft. of 60-in. cast iron pipe sewer in Jackson St., at an estimated cost of $10,000, is being discussed, the work to begin by June 29.

LOWELL, MASS.—Shepard, Russell & Fuller have petitioned for sewers at the Oaklands.——It is proposed to construct sewers in nine streets.

MALDEN, MASS.—The council has passed an ordinance authorizing an issue of $150,000 in bonds for sewers.

SPRINGFIELD, MASS.—The sewer commissioners have voted to advertise for bids for a sewer from Masonic to Center Sts.

TAUNTON, MASS.—The commissioners are again considering plans for a system.

BRIDGEPORT, CONN.—It is proposed to construct sewers in five streets. F. C. Mullins, Cy. Clk.

BUFFALO, N. Y.—The board of public works has received the following bids for constructing a 24 and 21-in. brick, and 19 to 10-in. pipe sewer in Le Roy Ave.: Jacob Ritzman, $4,600; W. A. Rappich, $4,500; F. J. Koglin, $4,773; August Gisel, $4,544; John Harrer, $3,800; William Franklin, $4,700; George W. Moore, $3,758; Christopher Smith, $4,199; F. J. Martin, $4,242; Henry Harter, $6,593; Elmer Mighton, $4,029.

BROOKLYN, N. Y.—Bids are asked until June 3 for extending and repairing the Fulton St. outlet sewer. A. T. White, Comr. Cy. Wks.

HORSEHEADS, N. Y.—The governor has signed a bill authorizing an expenditure of $10,000 to construct a sewer from the junction of the Chemung Canal and Chemung Canal feeder to Newtown Creek.

ITHACA, N. Y.—Henry N. Ogden, Ch. Engr., writes us that bids will probably be asked this week for constructing three miles of main sewers and for the outfall, and for the pumping station as soon as possible.

KINGSTON, N. Y.—W. Klingberg, Cy. Engr., has recommended the construction of a combined system in Wards 2 and 9, comprising about 14,450 ft. of 24-in. pipe and 36-in. brick sewers, and estimated to cost $115,000.

NEW YORK, N. Y.—Bids are asked by the department of public works until June 11 for constructing sewers in nine streets.

TROY, N. Y.—Bids are asked until June 4 for constructing 15 and 12-in. pipe sewers in four streets. E. O. Ross, Secy. Comptroller's Office.

NEWARK, N. J.—The two lowest bids received by the board of public works for constructing the Fifth Ave. system were from Bellingham & Satchwell, at $19,483, and Headley & Christie, at $19,820.——Phillip H. Harrison has been awarded the contract for constructing lateral sewers in two streets, at $6,562. It is proposed to construct pipe sewers in 24 streets and brick sewers in two streets. A. M. Linnett, Clk. Bd. St. Comrs.

ORANGE, N. J.—It is reported that the council has about settled its difficulties with the Empire Construction Co., and the Delafield Construction Co., and the council will be left free to go on with the completion of the system in the First Ward. It is estimated that it will require $90,000 or $100,000 to complete the entire system.

PLAINFIELD, N. J.—Bids are asked until June 10 for the construction of 6,590 ft. of 24-in. sewer, of which 2,770 ft. will be over 16 ft. deep, with manholes, branches, etc., as stated in our advertising columns. Jas. T. MacMurray, Cy. Clk.

ALLEGHENY, PA.—The council has passed an ordinance to issue $200,000 in 3½% sewer bonds. Robert Dilworth, Cy. Clk.

CINCINNATI, O.—Bids are asked by the board of administration until June 21 for constructing a sewer in Carthage Pike.

SALEM, O.—Morris French, Cy. Engr., has completed plans for a system in a portion of the city, estimated to cost $50,000.

YOUNGSTOWN, O.—Bids are asked until June 10 for the purchase of $325,000 of 5% sewer bonds. J. H. Edwards, Cy. Clk.

EVANSVILLE, IND.—The water-works trustees have recommended the construction of a 30-in. pipe sewer 900 ft. in length, estimated to cost $3,000, to a point 300 ft. below the water-works intake tunnel.

McCOMB, ILL.—This city and county are to build jointly a 24 to 18-in. sewer one mile in length, work to begin in 60 days. W. E. Thompson, Chn. Com.

STERLING, ILL.—Bids are asked until June 13 for the construction of the West Broadway sewer system, as stated in our advertising columns. J. F. Utley, Chn. Com.; J. F. Barrett, Cy. Clk.

IOWA CITY, IA.—The council has voted to construct a system. G. B. De Sellem, Cy. Clk.

ROCHESTER, MINN.—The assistant city engineer has been directed to prepare specifications for 6,000 ft. of 15 to 10-in. pipe sewers in Broadway.

WACO, TEX.—R. W. Jablonowski, Cy. Secy., informs us that bids were received from the following for constructing 14,500 ft. of 15 to 8-in. pipe sewers, recently noted in these columns: John Badde, Waco, Tex.; A. Ockander, Waco, Tex.; W. E. Jackson, Waco, Tex.; J. E. Riley, Omaha, Neb., present address Waco, awarded contract at $9,300; Geo. S. Miller, Houston, Tex.

HAMILTON, ONT.—The engineer has recommended the construction of a sewage pumping station, estimated to cost $22,300.

GARBAGE DISPOSAL.

JAMESTOWN, N. Y.—The mayor has suggested that a more economical system of garbage disposal be found.

NYACK, N. Y.—The contract for removing ashes and garbage has been awarded to Smith Lydecker at $90 a month.

HOBOKEN, N. J.—The bids for the collection and removal of ashes and garbage ranged from $4,300 to $6,500, if collected in the day time, and from $6,400 to $10,000 for night work. The bids for the cremation of garbage, the contract to include the collection, were as follows: Antonio Monacco, $20,000; Oscar Frommel, $19,000; S. G. Smith, of Bloomfield, $12,500, in consideration of a five-year contract; and I. H. Flaherty, Jr., $13,950. The latter bid was accompanied by an offer to erect a 60-ton crematory.

MONTCLAIR, N. J.—At the last monthly meeting of the Town Improvement Association the subject of garbage cremation was discussed and a lecture on the subject given by W. F. Morse, of the Engle Sanitary & Cremation Co.

ORANGE, N. J.—It is reported that a company has offered to collect the garbage and dispose of it in a sanitary way at least five miles from the city limits, at $1.85 for each two-horse truck load.

TRENTON, N. J.—Bids are asked until June 4 for the disposal of garbage by reduction or utilization system. C. Edward Murray, Cy. Clk.

WASHINGTON, D. C.—Bids are asked by the district commissoners until June 24 for the collection and disposal of garbage for four years and eight months from Nov. 1.

DAVENPORT, IA.—The contract for collecting garbage for the ensuing year has been awarded to Chris Burger, at $1,147. Mr. Burger is the present contractor.

KANSAS CITY, MO.—H. R. Kelly, representing the American Reduction Co., has been in this city endeavoring to obtain a contract from the city authorities for the disposal of the garbage of the city. A local paper states that the company offers to build a crematory at its own expense and burn the garbage, provided the city will give it a five-year contract.

CONTRACT PRICES.

MACADAMIZING.—Alfred, N. Y.—The contract for macadamizing the road from Alfred to Alfred Station, Allegany Co., N. Y., for which bids were received May 8, as advertised in Engineering News, has been awarded to the Rochester Construction Co., of Pittsburg, Pa., at 45 cts. per sq. yd. for 12-in. and 10-in. work, 18 cts. per sq. yd. for 3-in. top dressing, and 20 cts. per cu. yd. for excavation. F. A. Dunham, Plainfield, N. J., Engr. in Charge.

SEWER MATERIALS.—Baltimore, Md.—The following contracts were awarded for furnishing materials for the construction of a sewer in Luzerne St., between Boston and Hudson Sts.: For cement—Cumberland brand, B. Wallis & Co., 95 cts. a bbl., delivered in

bags; Round Top brand, J. S. Bullock & Son, $1.05 a bbl., in bags; Portland cement, Porta brand, National Building Supply Company, $2.40 a bbl. Lumber—Piles, J. S. Hoskins, 12 cts. a lin. ft.; cap-logs and flooring, P. M. Womble, $17.49 per M. ft., B. M. Stone—J. H. Atkinson, $1.70 a cu. yd. Bricks, hand made—Smith & Schwarz Brick Co., $6.75 per M. Sand—J. J. Gallagher, 63 cts. a cu. yd.

EXCAVATING SOIL AND GRADING ROADS.—Cambridge, Mass.—L. M. Hastings, Cy. Engr., informs us that the following bids were received May 22 for excavating soil and grading highways at Hobbs Brook storage basin:

Bids for Excavating Soil and Grading Highways, Hobbs Brook Storage Basin, Cambridge, Mass.

Section A.		J. A. Leavitt, 299 Wash. St., Boston.	Neil McBride, Brighton.	Gennaro, Long & Little.	Frank Saucier, Boston.	Chas. McDermott, Brockton.	Roxbury Granite Co., Keene, N. H.	M. Effie Vincent, Little & Co.	W. B. Strang, Jr., & Co., Boston.	McNeice, Cuzzo & Co.	Hendrick, Taylor & Warner, Northampton.	Rowe & Hall, Boston.	W. T. Davis & Co., Boston.	Ed. Phelan, Omaha, Neb.	Wm. H. Magee, W. Newton.	McCusker Bros., Brockton.
Soil and earth excavation	90,000 cu. yds.	$0.15	$0.16⅞	.18¾	.20	.20¼	.22½	.22	.23¾	.25	.28	.27	.24	.22	.30	.30
Highway grading	20,000 " "	.21	.23	.21½	.21	.27	.24	.27	.32	.30	.23	.27	.30	.35	.30	.35
Roadway surfacing	2,000 " "	.30	.30	.25	.45	.35	.24	.35	.40	.40	.25	.65	.30	1.50	.30	.35
Field stone, slope paving	830 " "	1.30	1.50	.90	1.60	.75	.90	2.25	1.50	1.70	1.00	1.35	3.75	3.00	1.25	.75
Placing 48-in. iron pipe	2 culverts.	150.00	150.00	100.00	100.00	300.00	150.00	300.00	200.00	270.00	10.00	215.00	350.00	1,000.00	.50	350.00
Fencing	6,600 lin. ft.	.14	.18	.20	.20	.15	.10	.20	.21	.12	.15	.15	.28	.15	.20	.20
Total Section A		$20,603	$23,120	$23,942	$25,948	$26,658	$27,237	$29,688	$31,606	$32,943	$32,140	$33,541	$33,861	$35,280	$36,058	$37,342
Total, Section B		26,617	30,675	30,907	35,875	37,875	38,445	39,127	39,165	.....	44,890	45,317	44,119	40,010	43,532	50,653

PIPE, VALVES, ETC.—St. Louis, Mo.—The lowest bids received by the water commissioners May 17 for pipe, etc., were as follows: For 850 tons of pipe, Shickel, Harrison & Howard Iron Co., $17,816; for 100 tons of special castings, Shickel, Harrison & Howard Iron Co., $4,170; for 475 fire plugs, Pleuger & Henger Mfg. Co., $7,275; for 125 6-in. stop-valves, Fulton Iron Wks., $1,581.25.

DREDGING.—New York, N. Y.—The Atlantic Dredging Co. has been awarded the contract for 100,000 cu. yds. of dredging in the North River, at 18 cts. per cu. yd., and that for 15,000 cu. yds. of dredging in the Harlem River, at 22 cts. per cu. yd. The other bids were as follows: J. H. Fenner, 19 cts. and 23 cts., respectively; R. G. & J. S. Packard, 18½ and 22½ cts.; Morris & Cumings Dredging Co., 18 3-5 cts. and 25 cts.; R. S. Ross, 18¼ cts. and 26 cts.; W. H. Bentley, 18¼ cts. and 23 cts.

BRIDGE MASONRY.—Clarion, Pa.—The following bids were received by the county commissioners May 14 for the stone work of a bridge across the Clarion River at the mouth of Piney Creek, the contract being awarded to R. A. Bigley, of Franklin:

	Per cu. yd.
R. A. Bigley	$7.49
C. E. Rodgers	6.47
John L. Weigand	6.37
Nelson & Buchanan	8.50
J. N. Moore & Dempsee	8.95
J. H. Alcorn	8.00
F. P. Stevenson	8.27
P. H. Melvin	8.19

DAM.—Cambridge, Mass.—L. M. Hastings, Cy. Engr., informs us that the following bids were received May 22 for constructing the Lincoln St. dam and appurtenances in the town of Lincoln:

BIDS FOR CONSTRUCTING LINCOLN ST. DAM AND ITS APPURTENANCES; CAMBRIDGE, MASS.

Quantities.		Gennaro, Long & Little.	John Noyle, Sharon, Mass.	Wm. H. Magee, W. Newton.	Standard Construction & Supply Co.	Hendrick, Taylor & Warner, Northampton.	Neil McBride, Brighton, Mass.	McNeice, Cuzzo & Co.	Roxbury Granite Co., Keene N. H.	F. A. Snow, 13 Broad St., Boston.	McCusker Bros. Waltham.	Rowe & Hall. Boston.	Ross & French. Waltham.
Surface excavation	1,000 cu. yds.	$0.25	$0.25	$0.30	$0.26	$0.30	$0.25	$0.25	$0.30	$0.30	$0.30	$0.30	$0.50
Trench excavation	3,000 " "	.40	.22	.40	.33	.35	.60	.35	.375	.75	.50	.75	.70
Rock excavation	50 " "	1.50	1.35	3.00	1.50	1.25	2.00	3.00	1.00	1.50	3.50	3.25	3.80
Earth filling	12,200 " "	.27	.24	.30	.38	.28	.30	.31	.35	.40	.30	.38	.56
Roadway surfacing	300 " "	.25	.75	.30	.33	.25	.30	.35	.30	.60	.35	.65	1.00
Loam on embankment	500 " "	.22	.25	.23	.40	.25	.30	.26	.50	.30	.25	.30	.40
Sodding	500 sq. yds.	.15	.75	.27	.18	.10	.25	.15	.12	.30	.25	.30	.30
Seeding	1,000 " "	.03	.20	.01	.005	.02	.05	.01	.02	.10	.01	.01	.05
Concrete foundations American cement	100 cu. yds.	4.00	5.30	4.75	4.10	5.50	5.00	5.00	4.90	5.00	6.00	5.25	6.50
" " Portland cement	100 " "	6.00	6.25	6.50	5.50	6.50	7.00	6.00	7.00	6.50	7.50	6.50	7.50
" core wall	1,300 " "	4.00	5.20	4.50	4.25	5.50	4.50	4.50	4.90	5.00	5.00	5.25	6.50
Plastering core wall	1,300 sq. yds.	.10	.25	.40	.27	.25	.70	.20	.25	.40	.25	.45	.25
Brick masonry, American cement	70 cu. yds.	14.00	10.30	13.00	14.00	12.00	13.00	12.00	8.50	15.00	13.00	15.00	12.00
" " Portland cement	20 " "	17.00	11.40	15.00	14.50	14.00	14.00	13.50	9.50	17.00	14.50	17.00	14.00
Ledge stone, American cement	30 " "	5.00	4.75	4.00	3.25	5.00	4.08	5.00	5.00	5.00	5.50	5.00	4.00
Granite masonry, American cement	160 " "	7.00	5.80	6.50	7.75	9.00	6.67	9.00	8.00	7.00	13.50	8.00	25.00
Squared stone, American cement	50 " "	13.00	7.95	12.00	11.00	16.00	13.08	12.00	18.00	10.00	16.00	15.00	35.00
Quarry-faced ashlar, American	25 " "	18.00	16.70	18.00	15.81	20.00	19.68	14.00	18.00	15.00	17.00	18.00	40.00
Dimension stone, Portland cement	15 " "	30.00	28.00	30.00	35.00	16.00	30.00	25.00	25.00	35.00	22.00	28.00	50.00
Coping stone, Portland cement	10 " "	50.00	16.50	15.00	25.00	16.00	14.00	25.00	27.00	25.00	24.00	25.00	50.00
Six-cut work	300 sq. ft.	.20	.50	.50	1.10	.25	.50	.50	.50	.60	.60	.60	.60
Fine pointed	300 " "	.25	.38	.50	1.10	.15	.50	.75	.50	.60	.50	.50	.50
Quarry stone, slope paving	900 cu. yds.	3.00	3.75	3.00	3.25	2.25	3.00	3.50	4.50	3.00	5.00	4.00	3.50
Field stone, slope paving	600 " "	1.00	.95	1.25	1.75	1.00	1.35	2.00	1.25	3.00	3.00	2.00	2.50
Broken stone	500 " "	2.00	1.05	1.25	1.25	2.00	1.25	1.75	3.00	2.00	2.25	1.75	2.23
American cement	200 bbls.	1.30	1.50	1.50	1.40	1.50	1.25	1.30	1.40	1.50	1.50	1.32	1.30
Portland cement	50 "	3.25	2.70	3.00	2.75	3.50	2.60	2.60	2.80	2.50	2.75	2.60	3.00
Iron work	5,000 lbs.	.02	.035	.06	.05	.10	.04	.06	.05	.05	.05	.06	.10
Flush boards	3 sets	45.00	11.50	5.00	16.50	15.00	5.00	16.00	25.00	10.00	15.00	22.00	14.00
Composition rungs	100 lbs.	.05	.06	.10	.28	.10	.10	.30	.10	.25	.40	.20	.15
H.-P. stringers and wall plates	5 M. ft.	35.00	35.00	30.00	50.00	40.00	28.00	45.00	45.00	40.00	45.00	35.00	50.00
H.-P. plank	1 M. ft.	35.00	35.00	30.00	50.00	40.00	28.00	40.00	45.00	40.00	45.00	30.00	40.00
Spruce lumber	1 M. ft.	20.00	20.00	20.00	22.00	25.00	25.00	24.00	35.00	30.00	30.00	23.00	30.00
Lumber in trenches	5 M. ft.	18.00	20.00	20.00	22.00	20.00	13.00	15.00	20.00	20.00	13.00	15.00	15.00
Fencing	1,200 lin. ft.	.20	.15	.20	.36	.15	.15	.16	.25	.50	.20	.15	.30
One gate house		900.00	955.00	1,400.00	18.00	1,200.00	1,500.00	1,500.00	1,300.00	1,200.00	1,000.00	2,500.00	1,200.00
Total		$22,636	$23,340	$24,275	$24,406	$24,763	$25,279	$25,461	$27,620	$29,325	$29,627	$30,896	$38,642

PIPE AND HYDRANTS.—Moorehead, Minn.—The contract for water pipe is reported to have been awarded to J. G. Robertson, of St. Paul, Agent for the South Pittsburg Iron & Pipe Works, of South Pittsburg, Tenn., at $25.60 per ton, f. o. b. at Moorhead, and that for hydrants to the Waterous Engine Works Co., of St. Paul, at $26 each.

DITCH EXCAVATION.—Monticello, Ind.—Web P. Bushnell, Engr., writes us that at the Big Creek ditch sale on May 15, the dredging firm of Behymer & Co., of Celina, O., secured the largest portion sold to any one firm, at prices ranging from 5 8-10 cts. to 7⅛ cts. per cu. yd. Harvey McAllister, of Hoopeston, Ill. (dredge), secured about five miles on one branch at prices ranging from 5.8 cts. to 6¼ cts. The bidders for the dredging work were as follows: R. H. McWilliams & Co., of Chicago; Behymer & Co., Celina, O.; J. W. Boyer, North Manchester, Ind.; J. C. Vanatta, Brookston, Ind.; Jas. P. Karr, Monticello, Ind.; Uhl & McNitt, Logansport, Ind.; J. Morrissey, Peru, Ind.; Miller & Williams, Marion, Ind.; Harvey McAllister, Hoopeston, Ill.

RAILWAY.—Grand Rapids, Mich.—The contract for building an extension of the Chicago & West Michigan Railway to Turtle Lake, Mich., a distance of seven miles, has been awarded to McDonald Bros. & Co., of Grand Rapids, at $1,643 a mile. This price includes clearing, grubbing, grading, tracklaying and ballasting. The other bidders were as follows: Clark & Fausey, Hastings; Nels Bye, Hastings; J. J. Grandville, Saginaw; Ole Peterson and J. H. Roberts, of Grand Rapids. Ch. Engr., J. J. McVean, Grand Rapids, Mich.

STREETS AND ROADS.

HYDE PARK, VT.—A meeting will be held June 4 to elect village officers and take steps for local improvements.

AMHERST, MASS.—It is reported that E. E. Davis is to make surveys for a highway from the college hall to the Hadley line, to be submitted to the state commissioners as a state road.

NEW BRITAIN, CONN.—The committee has recommended that the council engage a road engineer.

ALBANY, N. Y.—Bids are asked until June 3 for paving Judson St. with granite blocks. T. J. Lanahan, Clk. Bd. Contract.

BROOKLYN, N. Y.—Bids are asked until June 6 for paving portions of seven streets with granite blocks and portions of five streets with asphalt. A. T. White, Comr. Cy. Wks.

BROOKLYN, N. Y.—The mayor has signed a bill authorizing an appropriation of $50,000 for paving the west drive of the Ocean Parkway with brick; an appropriation of $130,000 for paving a portion of Fort Hamilton Ave. with brick, and also for paving Bay Parkway from the Ocean Parkway to Gravesend Bay.

NORTH TONAWANDA, N. Y.—It is reported that the desired number of signatures has been secured for paving Payne St.

ROCHESTER, N. Y.—The city engineer is preparing to advertise for bids for paving Upper South Ave. with macadam and Medina stone, estimated to cost $44,000.

OLEAN, N. Y.—The council has been petitioned to pave 4,650 lin. ft. of West State St. with brick.

ATLANTIC CITY, N. J.—The council has voted to pave Illinois Ave. with telford macadam.

BELLEVILLE, N. J.—The township committee has directed the chairman to advertise for bids for grading Rutger St, and also for the purchase of $68,000 in 4% bonds for macadamizing.

BOUND BROOK, N. J.—Bids are asked by the council until June 11 for about 4,400 lin. ft. of macadamizing.

ELIZABETH, N. J.—It is proposed to pave portions of Stiles and Cherry Sts. with trap block pavement on the sides and telford, 15 ins. deep, in the center, at an estimated cost of about $22,000.

HOBOKEN, N. J.—A resolution has been introduced by the freeholders authorizing the committee to investigate the advisability of constructing a road.

JERSEY CITY, N. J.—Bids are asked until June 17 for 2,550 sq. yds. of Belgian block paving, 49,400 cu. yds. of earth filling, 3,000 cu. yds. rock excavation, etc. John C. Kaiser, Chn. Com.

JERSEY CITY, N. J.—Bids are asked until June 17 for 2,500 sq. yds. of brick paving on concrete foundation, 3,333 sq. yds. of stone and granolithic flagging, 1,100 ft. of 24-in. cast iron pipe sewer, etc., in connection with the proposed steel viaduct in Mercer St. John C. Kaiser, Chn. Com.

NEWARK, N. J.—The freeholders have directed the county engineer to advertise for bids for grading the road on Pompton Turnpike.

NEWARK, N. J.—It is proposed to pave portions of three streets with asphalt, two with granite blocks and two with trap rock. A. M. Linnett, Clk. Bd. St. Comrs.

ORANGE, N. J.—Bids are asked until June 3 for about 6,000 sq. yds. of macadamizing, 2 contracts, the work including 1,520 cu. yds. of excavation, etc. Louis D. Gallison, Chn. Com.; John P. Dexheimer, St. Comr.

PATERSON, N. J.—The aldermen propose to pave portions of a number of streets with Belgian blocks, asphalt, etc.

TRENTON, N. J.—It is proposed to pave two streets with brick. C. E. Murray, Clk.

JOHNSTOWN, PA.—The council has passed ordinances for paving portions of 10 streets, estimated to cost about $50,000, and four streets with cobblestones, to cost about $3,300.

PHILADELPHIA, PA.—Bids are asked until June 4 for paving and grading certain streets. Thos. M. Thompson, Dept. Cy. Wks.

WILKES BARRE, PA.—Bids are asked until June 5 for paving three streets with brick and two streets with asphalt. J. M. Kirkendall, Chn.; Frank Deitrick, Cy. Clk.

WILMERDING, PA.—Bids are asked until June 4 for about 2,990 cu. yds. of earth excavating on Welsh Ave. C. C. Cowell, Borough Clk.

UNIONTOWN, PA.—Bids are asked until June 4 for 4,464 sq. yds. of brick paving, 2,982 lin. ft. of curbing, etc. Cooper & Van Swearingen, Village Solicitors.

WILMINGTON, DEL.—It is proposed to pave portions of 11 streets.

LAUREL, MD.—Bids are asked until June 3 for grading and constructing brick sidewalks in Main St., as noted last week. J. W. Gray, Clk. Council.

CINCINNATI, O.—Bids are asked until June 6 for paving Court St. with granite blocks. A. P. Butterfield, Clk. Bd. Administration.

LIVERPOOL, O.—It is proposed to pave 4,000 sq. yds. of Lincoln Ave. with brick, the work including 2,000 ft. of curbing. John A. George, Cy. Engr.

UPPER SANDUSKY, O.—Bids are asked until June 11 for constructing about one mile of roads, according to reports. W. E. Bowsher, Clk.

VAN WERT, O.—Bids are asked until July 2 for about 10,600 sq. yds. of brick and macadam paving. O. F. Manship, Village Clk.

DETROIT, MICH.—It is proposed to pave portions of ten streets with cedar blocks on concrete foundation, at an estimated cost of $95,000.

LOGANSPORT, IND.—Bids are asked until June 15 for paving Market St. with brick, according to reports. J. B. Winters, Clk.

MATTOON, ILL.—Bids are asked until June 18 for paving portions of two streets with brick, and one with telford macadam, according to reports. W. A. Flowers, Cy. Clk.

MUSCATINE, IA.—The question of paving 30 blocks with bricks is being considered by the council.

ST. LOUIS, MO.—Bids are asked until June 7 for furnishing macadam stone screened gravel and red or gray cement gravel for constructing and reconstructing brick and artificial stone sidewalks and curbs for one year. E. S. Foster, Secy. Bd. Pub. Improvements.

SEATTLE, WASH.—The council has been petitioned to pave a portion of Front St. with brick, which the city engineer estimates will cost $30,000.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CEMENT, ETC.—Washington, D. C.—Bids are asked until June 5 for a quantity of cement, building stone, piles and lumber for the Washington navy yard. Edwin Stewart, Paymaster Gen.

STREET CLEANING.—Washington, D. C.—Bids are asked by the district commissioners until June 4 for street cleaning.

STEAM ROAD ROLLER.—Medina, N. Y.—It is probable that a steam road roller will soon be purchased by this village.

DREDGING.—Baltimore, Md.—Bids are asked until June 7 for 125,000 cu. yds. of dredging. N. W. Hutton, Engr. Harbor Bd.

RETAINING WALLS, ETC.—New York, N. Y.—Bids are asked by the department of parks until June 5 for the construction of three retaining walls, etc.

DAM WORK.—Winona, Minn.—About 200 ft. of the Sugar Loaf mill dam was washed out a few weeks ago, which it is reported will be rebuilt at once. Address C. W. Anding.

SAND, BROKEN STONE, ETC.—Washington, D. C.—Bids are asked by the district commissioners until June 6 for furnishing sand, pebbles and broken stone, as stated in our advertising columns

ROUND HOUSES.—New Haven, Conn.—The New York, New Haven & Hartford R. R. Co. has plans prepared for three new round houses, for which contracts will probably soon be awarded, as noted under Railways.

FOUNDATIONS.—Cleveland, O.—Bids are asked until June 13 for furnishing materials and labor for the construction of crib and stone foundations for beacons of Sandusky Bay range light station, as stated in our advertising columns. Lieut. Col. Jared A. Smith, U. S. Lighthouse Engr.

METAL MARKET PRICES.

LEAD.—New York: 3.2 to 3.25 cts. Chicago: 3.05 to 3.1 cts. St. Louis: 2.95 to 3 cts.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $10.25 to $11.25. Chicago: $9.75 to $10.75.

TRACK MATERIAL.—New York: angle bars, 1 to 1.1 cts.; spikes, 1.35 to 1.4 cts.; track bolts, 1.75 to 1.9 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars,1.2 to 1.3 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.8 to 1.9 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11.50 to $12 for iron, and $10 to $10.50 for steel; steel rails fit for relaying, $14; light rails, $20 to $22; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $11.25 to $11.75 for iron, and $8 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.3 to 1.35 cts.; steel plates, 1.3 to 1.35 cts. for tank, 1.35 to 1.45 for shell; 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.55 cts.; channels, 1.2 to 1.5 cts.; angles, 1.15 to 1.2 cts.; tees, 1.3 to 1.35 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.25 to 1.3 cts. for shell, 1.3 to 1.4 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts.; channels, 1.4 to 1.45 cts.; angles, 1.3 to 1.4 cts.; tees, 1.55 to 1.6 cts.; universal plates, 1.3 to 1.4 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.55 to 2 cts. for flange, 2 to 4.5 cts. for firebox

IRON AND STEEL.—The "Journal of Commerce" says that orders for pig iron from foundry in this state and New England are fair, but the buying is very conservative. Other buyers are taking hold in a very indifferent way. There appears, however, to be enough business to keep prices quite steady. In old material a very fair amount of business is passing, but there are no particularly large deals in any one class of stock. New orders for steel rails have been few, and the business from inquiries that were on the market some time ago has not materialized in full. In other heavy products there is a fair business, but not enough to stiffen values.

INDUSTRIAL NOTES.

THE O. S. KELLY CO., of Springfield, O., has sold one of its 12½-ton steam rollers to the city of Mankato, Minn.

THE MILWAUKEE BRIDGE & IRON CO., of Milwaukee, Wis., has a contract for six iron bridges at Plattville, Wis.

THE PHOENIX IRON CO., of Phoenixville, Pa., has the contract for the ironwork for two rolling mill buildings, 100 × 200 ft., for the Reading Iron Co., of Reading, Pa.

THE Q. & C. CO., of Chicago, Ill., has made arrangements for the manufacture of the Servis tieplates by the Pennsylvania Steel Co. and the Illinois Steel Co.

THE ELLIOTT CAR CO., of Gadsden, Ala., is building 250 box cars and 150 gondola cars for the Louisville & Nashville R. R., and 150 fruit cars for the Southern Ry.

THE DIAMOND LINSEED OIL CO., of Columbus, O., will establish its plant at Elyria, O. The company has a capital stock of $100,000, and its president is A. L. Garford, of Elyria.

ERNEST S. CRONISE, of 37 Broad St., New York, has arranged to represent H. K. Porter & Co., of Pittsburg, Pa., manufacturers of light locomotives, compressed air locomotives and electric motors.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., bought the plant of the Johnson Railroad Signal Co., at Rahway, N. J., at the sale by the Receiver; but the sale is subject to the approval of the Chancellor.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has a contract for a foundry building for the Malleable Iron Fittings Co., of Branford, Conn., and for the refrigerator plant of the International Cooling Co., at Atlantic City, N. J.

THE DUPLEX CAR CO., of Concord, N. H., has been organized to build combination cars for summer and winter service on street railways. Capital stock, $1,000,000. Pres., H. A. Tuttle, Pittsfield, N. H.; Treas., Austin H. Roby, Boston, Mass.

THE W. J. McCLURG GAS CONSTRUCTION CO., of Pittsburg, Pa., states that it is not interested in the Lubrig gas motor for street cars, as reported, except as a manufacturer of gas producers. It makes a specialty of the Miller "zig-zag" reversible gas generator.

THE WADDELL-ENTZ ELECTRIC CO., of New York, had its factory at Bridgeport, Conn., sold by auction May 22, and the property was bought by Percival Knauth, of New York, for $60,000, including the patents on storage-battery street cars, the cars formerly tried on Second Ave., New York, and the works at Bridgeport.

THE TOLEDO BRIDGE CO., of Toledo, O., is building a bridge 449 ft. long and 64 ft. wide for Hamilton, O., and has 11 plate girder spans to build for the Toledo, Ann Arbor & North Michigan R. R., and has just completed 11 spans, making 22 spans for this road. It also has a contract of a bridge over the Maumee River at Toledo, 3,714 ft. long, 24 ft. roadway and two 8-ft. sidewalks, besides a number of small highway bridges.

THE JOHNSON RAILROAD SIGNAL CO., of Rahway, N. J., has had its plant sold by auction by E. S. Savage, the receiver. Two bids were received at first, one from the Hall Signal Co., for $65,000, and one from J. C. Richardson for $50,000. The creditors objected to all bids, and the court ordered another sale, when the only bid was by Oakleigh Thorne, of the National Switch & Signal Co., for $40,000. This bid will be presented to the chancellor on June 3 for confirmation.

THE STANDARD ELECTRIC CO., of Chicago, Ill., is reported to have increased its capital stock from $1,000,000 to $1,500,000 in order to provide increased manufacturing facilities. This is the company which bid a very low rate for lighting at the Columbian Exposition, when a combination of some other companies had put the rate very high. Its service plant in the Machinery Hall worked 25,500,000 arc lamp hours without the loss of an armature or an armature coil. The company is considering the leasing of a large factory and the purchase of a number of machine tools. Pres., A. G. Spalding; Gen. Man., D. P. Perry.

NEW COMPANIES.—Automatic Fluid Elevator Co., Lansdale, Pa.; $30,000, with $3,000 paid in; James Gould, 3636 North Broad St., Philadelphia, Pa., and Horace E. Jenkins, Lansdale.

Canels Trolley Co., Springfield, Ill.; $100,000; Frank W. Canels, Adam M. Ross and T. H. Pearse.

Praul Aero-Motor Co., Philadelphia, Pa.; $25,000; J. E. Praul, W. W. Roach and Harrison Johnson.

Delany Heater & Rheostat Co., New York, N. Y.; $100,000; J. R. Steers, J. H. Delany and E. T. Birdsall.

Delaware Street Sweeping Machine Co., Wilmington, Del.; Pres., James B. Austin, Buffalo, N. Y.; Secy., Conrad F. Clothier, Jr., Philadelphia, Pa.

PROSPECTIVE ADVERTISERS in Engineering News should bear in mind that this paper is published on Thursday and that the last pages go to press Wednesday afternoon. Proposal advertisements and news items are constantly being received too late for insertion the week intended, and each of the last two weeks we have received bridge proposal advertisements on Thursday morning with orders to insert in the issue of that week. We were unable to print the advertisements; the advertisers failed to have their work given the publicity they had intended, and many of our readers were thus kept in ignorance of the work. Bear in mind that the last pages of Engineering News go to press on Wednesday and send us your items of news and proposal advertisements as early in the week as possible. The issue of this week, owing to the holiday, went to press on Tuesday.

PROPOSALS FOR WATER-WORKS,

sewers and other municipal work should be inserted in Engineering News, which would bring the work to the attention of prominent contractors and manufacturers of contractors' supplies in all sections of the country, and thus insure a competition which would doubtless result in large savings on contracts.

MORE THAN 150 REPLIES were received, an engineer writes us, from a recent insertion of a water-works advertisement in Engineering News. It would have taken a large number of daily papers and cost a considerable sum of money to have secured this result by the old-fashioned method of advertising work only in daily papers.

NEARLY 1,000 DIFFERENT CITIES and towns have advertised work in this paper within a few years. This includes, in addition to large cities and important contracts, hundreds of smaller contracts in towns and villages representing nearly every section of the United States and Canada. Villages and small cities find this paper the best, as well as the most inexpensive, medium for bringing their work to the attention of desirable parties, and larger cities secure increased competition by advertising work in this paper. Many cities are now advertising all their work in Engineering News, and every city that does this saves money by so doing.

PROPOSALS FOR BRIDGE WORK

should be inserted in Engineering News, as this paper is read each week by nearly every bridge company and prominent bridge contractor in this country, and work advertised in these columns is thus given the utmost possible publicity.

ENGINEERING NEWS PRINTS MORE reliable news items, a larger number of proposal advertisements, and is much more extensively read by contractors and manufacturers of contractors' supplies than any other paper in America. These facts should be borne in mind. They may save you or your city large sums of money on contracts.

IN THE 21 ISSUES OF ENGINEERING NEWS from Jan. 3 to May 23 there were printed 210 different proposal advertisements, about 430 total insertions, asking for bids for work in over 115 cities and towns. Among the municipal advertisements were the following: Sewers, pipe and pumping engines at Brooklyn, N. Y.; sewers and bridges at Providence, R. I.; sewers, paving, etc., at Washington, D. C.; paving (5 advertisements) and water conduit, at Erie, Pa.; paving and sewers, at Peoria, Ill.; laying water pipe(4 advertisements, 13 insertions), at New Orleans, La.; large grading contract, at St. Louis, Mo.; steam road roller, at Toronto, Ont.; smoke-preventing device, at Rockford, Ill.; bridge work, at Boston, Providence, Cincinnati, Denver, Atlanta, Nashville and other cities; courthouse, at Baltimore, Md.; plans for art building, at Philadelphia, Pa; electric light plants in several cities; water-works construction in all parts of the country, including Astoria, Ore., and Santa Clara, Cal.; and also several railway contracts.